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September 13, 1923

Failure of Apishapa Dam, Colorado

Information given in the August 30 issue has been supplemented by more complete data, supplied by John E. Field, consulting engineer of Denver, and by Barton M. Jones and O. N. Floyd, engineers with the Dayton Morgan Engineering Company at Pueblo.

Japanese Engineering Works and the Earthquake

Notes on trend of building design, with particular reference to new steel structures in Tokyo—Modern water-works in Tokyo and Yokohama—Few cities have sewerage systems—Railways are nationalized.

Articles on Water-Works Practice

Deferrizing additional water supply of Berlin—Pitometer survey reveals many leaks in Detroit's supply—Disinfecting the city mains in Otsego, Michigan—Movement of B. Coli in ground water.

Also—

Six pages of Job and Office Articles

And—

Notes on Roads in the Orient

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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Structures and the Japanese Earthquake

LITTLE reassurance has come from Japan in the fragmentary bits of news that have drifted in since the first word of the earthquake of Sept. 1. A stupendous total of death and destruction is sure, even though the unavoidable exaggeration of first estimates has been slightly discounted. But there is somewhat better assurance than was available a week ago that the steel-frame and concrete buildings in the devastated area were not destroyed, as early rumors asserted, but survived substantially intact, as they did in San Francisco. This is at least an item of satisfaction, small though it be when measured in the total. It is now more certain too, that the violence of the movement was phenomenally great. Much is to be learned, therefore, from the effects of the earthquake in relation to safe construction, for the benefit of future generations. The full story of the engineering aspects of the disaster, however, will doubtless come only after weeks or months.

An Expedient Settlement

BY THE terms of the anthracite coal settlement the miners gain a horizontal raise in wages, the operators prevent the check-off and lose no part of their profits, the State of Pennsylvania will gain close to a million dollars extra taxes on coal exports, and the public will have to pay more for its coal. It is easy, therefore, to figure out who wins by the settlement. The best that can be said is that in all probability anthracite coal disputes have been prevented for another two years, at a cost to the citizen's purse. The proposed investigation of freight rates and middlemen's profits may result in an absorption of some of the increased cost before it reaches the consumer but the possibility is remote. Governor Pinchot can hardly be blamed for making expediency the governing element in the agreement. By the time the dispute reached him there was probably no other way out. The fact remains that the horizontal wage raise is inequitable, even admitting that some of the miners are entitled to more pay, and that the whole fabric of the cost of coal to the consumer is so complicated that it needs radical readjustment by some other method than making the user pay more. The result of the strike and the agreement is disappointment that the strike of last year and the organization of the Federal Coal Commission have produced such meager results.

Six Examples

THE value of underground water-waste surveys is forcibly illustrated by the six examples of leaks thus detected at Detroit that fill a page of this issue. These six leaks alone were wasting water at the rate of 0.8 m.g.d., while other underground leaks found by the pitometer brought the total to nearly 10 m.g.d. Even more leakage of other sorts was located by the water-waste survey, bringing the total to a saving of 24 gal. per capita. If so much can be done where 98½ per cent of the taps are metered what would similar efforts do in some of our cities with practically no meters in use and no reliable knowledge of what leaks and other wastes are occurring daily?

An Engineer Wins a Prize

FOR some time we have been contending editorially what too few engineers seem to have taken seriously —that the engineer is the logical person for the solution of our greatest municipal problem, the growing congestion of traffic in our city streets. We are pleased to record one instance in confirmation of the contention. Some weeks ago some theatrical interests in New York City, concerned no doubt at the prospective loss of business from the difficulty of gaining access to their doors, offered substantial prizes for the best solutions of the traffic problem in the metropolis. A committee—on which there was no engineer—has just awarded the first prize of $1,000 to Arthur S. Tuttle, the chief engineer of the Board of Estimate of the city. The details of the award are given in the news pages of this issue. We congratulate Mr. Tuttle on having demonstrated to some of the people of New York, at least, that this is a subject on which an engineer's views are worth while.

Mobile Construction Equipment

MANUFACTURERS are making long strides in producing mobile construction equipment. The contractor is no longer satisfied by merely putting wheels under a machine or even by low-geared self-propulsion; he demands speed of travel and manoeuvering ability. Where he cannot get these practicably by self-propulsion he is calling in the motor truck and fast tractor and requiring his concrete mixers and other machines to be provided with running gear for fast hauling or so arranged that they can be speedily loaded and unloaded for truck or trailer transportation. The railways originated the demand for such equipment, the street railways followed with its development to a remarkable degree and now highway work and general contracting are becoming insistent in their demand. It is also the contractor doing many small jobs and not particularly the contractor for large operations who most wants highly mobile equipment. It enables him to use machines for many tasks for which, if much time were required to move machines, it would be necessary to use men. An equally important gain which is coming to be appreciated is that it enables the economy of large capacity equipment to be extended to small operations. For scattered jobs of yard paving and commercial garage floors, for example, time enough is saved by a 21-E paving mixer, if it can be shipped quickly, to increase materially the volume of work a contractor

can handle. This is not speculation. There are contractors who are successfully using these large machines for scattered small paving operations. Outfits are known where a 21-E paver is loaded onto a motor truck trailer in 15 minutes; at its destination it is unloaded and at work in another 15 minutes. The move from job to job is made at a speed of eight to ten miles an hour. These developments are making the large machine an economic factor in small job contracting which deserves further study. Similar opportunities exist in other fields than paving, such as water-works and sewer extensions and repairs, to name only two examples.

The Berlin Deferrization Plant

THE Berlin iron- and manganese-removal plant described in this issue is interesting both in itself and because it brings to engineers outside of Germany an account of how Berlin handled a problem of this sort just before the war. It appears that the Berlin capital, which for years had been removing iron from its water supply by aeration and slow sand filtration, fell into line with the strong trend of American practice some ten years ago and for the plant completed in 1914 substituted rapid or mechanical for slow sand filters. The impinging jet aerators, the prefilters and final filters, both in arrangement and details, have notable features. Both sets of filters are operated at high rates. The injector wash for the final filters, used only after the ordinary reverse-flow and compressed-air wash becomes inefficient, brings to mind the ejectors in the drifting sand filters at Toronto. The doubling of the iron content of the water at Berlin in six years is in general line with what must often be reckoned with in underground water supplies. Finally, the architectural attractiveness of the buildings that house the plant may be noted as a feature worthy of emulation in this country, although it is a pleasure to be able to say that a goodly number of American cities are not unmindful of the fact that good architecture is a municipal asset even in utilitarian buildings.

Roadbuilding a Market for Steel

RARELY is thought taken of the steel maker as a materials producer for road construction. Yet in 1921, according to the Bureau of Public Roads, 2.1 per cent of the money spent for federal-aid roads was spent for reinforcing steel for concrete pavement and structures. As about $112,325,000 were put into federal-aid roads in the year named, the cost of reinforcing steel was about $2,376,000 or some $318 per mile for the 7,480 miles constructed. In round figures about 10,000 miles of new road of the first class has come to be our annual production. When to the reinforcing steel for this mileage we add the steel for road signs and guard rails, for steel bridges and for the equipment employed in building roads there is had a rather impressive sum represented, by the products of the steel maker, in highway construction. This is a continuing market. The federal-aid program alone contemplates 187,000 miles of highway of which over 160,000 miles are still to be constructed and federal-aid road is not over half of the mileage of state trunk-line roads that have been planned for construction. Roadbuilding has become an important factor in the metal-working industries.

Dangerous Warning Signs

PROPER warning signs, we all know, prevent accidents and promote safety. But improper or unnecessary warnings are positively dangerous. Some highway warning signs are of this kind, and give daily evidence of a need for revising and establishing consistent practice in the system of posting danger spots on roads. The sign "Danger—Sharp Curve" posted at a moderate bend misleads more than it warns; repeated, it produces disregard of all curve warnings or, worse still, it brings on sudden disaster when the driver comes to a sharp curve which by chance has the warning sign omitted altogether. Similarly, the important safety warning "Narrow bridge" becomes a danger when used needlessly. So long as narrow bridges, sharp curves and dangerous crossings continue to exist on roads and high-speed transportation is demanded, warning signals will be increasingly important. The highway art is yet young in respect to thorough signaling, but the demands of the day nevertheless call for early and well-considered development of good practice.

Efficiency Rather Than Politics

AN ENGINEER, in the person of Col. Frederick Stuart Greene, has been appointed by the governor as head of New York State's Department of Public Works, which has just come into being in accordance with the provisions of the state reorganization act which took effect July 1. The post is an important one, both politically and technically. While it could readily be assumed by a politically minded official to be anything but an engineering position it involves the administration of such engineering works as highways, bridges, public buildings, waterways and canals. The very nature and scope of the department's activities necessitate the spending of large sums of money and the filling of a long list of jobs, so that from the point of view of party patronage the superintendent of public works of New York State is in the position of being able to dispense many favors. It is natural to suppose that great pressure must have been brought upon the governor to appoint as head of this new department a man who could be relied upon to "do the right thing" by the job-seekers of the party in power. Yet Governor Alfred E. Smith, himself the choice of Tammany Hall, has had both the wisdom and the courage to select his superintendent of public works on the basis of administrative and technical fitness for the job in hand rather than upon that of political expediency. Colonel Greene is an engineer of wide experience, a member of the American Society of Civil Engineers, a former New York State highway commissioner, and, during the war, the commanding officer of a combat engineer regiment in the 77th Division. Appointments of this sort go a long way toward raising public officials to a new plane of respect in the minds of the electorate. If more governors of states and mayors of cities would follow Governor Smith's example of appointing properly qualified engineers to managerial jobs, it is certain that the taxpayers would reap untold benefits in the form of better and less costly public works. Incidentally, the Governor of New York might well read the Secretary of the Interior a lesson on how politics may be eliminated in the conduct of public office, especially where engineering service is the main work which is to be administered by the department head.

Elementary Road Types Not Overlooked

ELEMENTARY road types—earth, gravel, macadam—astonish us often with their ability to carry traffic satisfactorily, even traffic of modern swiftness and volume, when scrupulous care has been given to detail in construction and when the maintenance is continuous and thorough. Such construction and maintenance were the requirements set forth as invariably necessary for good road service in the first textbooks on roadbuilding written when no other than the simpler types were contemplated for rural traffic; they also were the requirements usually realized in the roadwork of England and France and very seldom realized then in the roadwork of America. In coming back from his survey of roads in the Far East, with the same thought outstanding, Colonel Crosby does not offer us a new lesson in what he says on another page; he but repeats an old one in danger of being forgotten, he feels, in our present epoch of paved roads and of motor-bus and truck traffic.

This reminder is good for us. We accept it appreciatively from a veteran road builder knowing that he does not mean to be taken quite literally in calling quantity production our golden calf and "permanent roads" a will o' the wisp.

There is found, indeed, when we come to examine the facts, much less variance than might be anticipated between Colonel Crosby's implied thought and present American roadbuilding practice. "Permanent roads" have been emphasized in the talk of engineer and layman alike until it has seemed that paved road construction predominated in the improved road mileages of recent years instead of being only a small fraction of the total improved road and an almost infinitesimal fraction of the total road.

Of about 25,000 miles of road improved with federal aid 27 per cent are paved roads. All the remaining mileage is road of the elementary types, largely earth, gravel and macadam. Generally, too, federal aid goes only to the main trunk-line state roads. If improved roads of all classes were taken, it is shown by the few state highway censuses available, the ratio of paved roads to other improved roads would be still smaller.

There is scant evidence in either statistics or observation that the highway engineers of the United States are forgetful of the truth that for years to come it will be good economics to build more miles of roads of simple types than of concrete and asphalt and brick. Indeed if any alarm is to be felt it is because at the present moment some of the major roadbuilding states are showing an inclination to swing too strongly toward other than paved road construction. Less comfort is got from the situation when maintenance of the kind thought of by Colonel Crosby is given consideration. We have too little of it. Yet in some states maintenance is very good and every year it is getting better in more states.

Parallel conditions in roadbuilding do not prevail in the Orient and in America and Colonel Crosby never assumes that they do. His thought is merely that in America, due to carelessness in construction and, chiefly, to neglect of upkeep, we do not get the quality of traffic service from our roads of the elementary types which is being obtained in countries where road improvement procedure is comparatively primitive. He is correct. This carelessness in building and maintenance, however, is more a tradition of the past than a practice of the present. Our earth and gravel roads of today's construction are radically different structures from those of twenty years ago and they are being kept up in a way that they never were before.

It is quite worth while to stress these facts because it is getting to be too complacently assumed by too many that highway engineers are running wild in paved road construction to the neglect of the simpler types which must for a long time constitute the majority mileage of our rural highways. Consequently we are having such occurrences as the recent actions of the politician governors of Ohio and Michigan in usurping the technical direction of highway development. American highway engineers may not have sensed everywhere at all times the controlling problems of highway development, but it is certain that there is no group of men having a better grasp of all the factors that enter into the creation of a great highway transportation system. It is important that this truth should be spread before the people.

Laymen Water Bacteria Hunters

IN CALIFORNIA the State Board of Health is advocating the establishment of laboratories in small towns to check bacterial reduction due to chlorination or other water treatment, even where trained bacteriologists are not employed. More or less similar efforts have been made by the health departments of several other states. The equipment for a "minimum" laboratory under the California plan, as itemized in our issue of Sept. 6, p. 401, would cost about $135, which is certainly well within the financial capacity of any water-works plant, however small.

The serious question that arises is whether the ordinary operator can be trained by a state health department or otherwise to make even the simplest bacterial tests. Of minor moment but worth consideration is the effect upon trained operators, if they must compete with the relatively untrained operators in charge of these "minimum" laboratories. The argument is that the "minimum" laboratories are simple and are put in only where the employment of an experienced laboratory man is entirely outside the financial capacity of the town. Would it be better, where one town cannot afford the full time of a trained operator, for a state health department to urge that two or three or more communities within reasonable distance of each other combine in the employment of a trained man? In some states, at least, water testing could be combined with other laboratory work for health protection, either in county or other district laboratories.

In considering this matter account should be taken of the false sense of security which may be created in a community relying on the work of the tyro in making bacterial media, maintaining sterile apparatus and taking and plating samples.

At the same time, conditions may exist in some if not in most states where the choice in many communities is between state health board efforts to bring training to the layman filtration or chlorination plant operator on the one hand or on the other to leave the plants in question in the charge of men ignorant of what constitutes safe drinking water and even more ignorant of the simplest means of testing it. Broadly, the staff of a state board or department of health is better fitted than any outsiders to choose a plan best suited to conditions within its own borders.

Failure of Apishapa Earth Dam in Colorado—II

Two Independent Reports Written After Investigations and Interviews at Site Agree that Failure Was Due to Conditions in Body of Earth Fill

The first report attributes the failure to poor material badly placed and compacted, resulting in settlement, caverns and saturation, with final burst of water diagonally through the top portion of the dam. Conclusions of the second report absolve all concerned from carelessness or slighted work and attribute the failure to unequal settlement due to bottom subsidence and movement, without stating the primary cause. The second report points out some elements of weakness which the authors do not think had anything to do with the failure. Preliminary reports by the same authors appeared in Engineering News-Record, *Sept. 30, p. 357.*—EDITOR.

Sequence of Events and Their Causes

BY JOHN E. FIELD
Consulting and Supervising Engineer, Denver, Colo.

AT ABOUT 3 p.m. on Aug. 22, a flood occurred in the Arkansas Valley of Colorado which constitutes, next to the great flood in the same valley in 1921, the greatest disaster that has befallen any agricultural community in the state. Considering the many irrigation works, their value, and the long period from 1860 to date that irrigation has been practiced, the comparative immunity from serious losses through failure of the irrigation works is remarkable. At the hour stated, the large earth dam on Apishapa Creek, some forty miles southeast of the town of Pueblo, failed.

Photograph from Barton M. Jones and O. N. Floyd

FIG. 1—GAP IN APISHAPA EARTH DAM CAUSED BY FAILURE ON AUG. 22

Looking north downstream. Each end of dam, with concrete cutoff walls built into abutting canyon sides, left standing; no damage done to the outlet tower at left or west end of dam.

At the time, the reservoir was practically full, the water being 1.1 ft. below the spillway level and about 10 ft. below the crest of the dam. The reservoir has an area of 640 acres and contained 18,500 acre-ft. of water. Briefly, the dam was 115 ft. high above river bed, 586 ft. long at crest, with 2 to 1 slopes on the lower and 3 to 1 on the upper side, and was located in a box canyon. The spillway was about one mile east from the dam.

Dwarf Cutoff Wall—Steel sheetpiling had been driven into the foundation to bedrock, surmounted by timber sheetpiling to the approximate level of the original ground forming the floor of the canyon. This sheetpiling terminated in concrete cutoff or baffle walls at each side of the canyon, which baffles extended up the sides to the crest of the dam. These portions of the structure have, so far as ascertainable, remained intact, as have also the outlet works, tower and tunnel.

The volume of fill in the dam is given as around 315,000 cu.yd., practically all of which was washed away. The water face was in part protected by rock riprap, which, however, did not reach to high-water level but remained uncompleted for some 20 ft. vertically below high water.

The reader is referred to the issue of *Engineering News-Record*, June 16, 1921, p. 1030, for a more detailed description of the dam and to p. 357 of the Aug. 30, 1923, issue for a cross-section of the dam and preliminary reports on its failure.

The material forming the lower layers of the dam, constituting, according to report, about half the total yardage, was taken from the bed of the reservoir above the dam and about one-fourth mile distant. The upper portion was of material taken from the mesa east of the canyon, also about one-fourth mile away. The plans called for selected material in the upstream four-fifths of the dam, but there appeared to be little difference between that portion and the downstream fifth. An examination of the plans shows that they were well conceived and that the work on the foundation, cutoff walls, etc., was excellent.

The material is fine sand with some cementing material. When wet it becomes very soft, though when shaken up with water in a vessel it settles to comparative clearness in a few minutes. When dried it becomes very hard and forms into lumps which are hard to break with the hand and into which an oak survey stake is driven with difficulty. To those familiar with western soils the description would be a light sandy soil with alkali.

Test of Soil from Dam—A sample treated with water for two hours resulted in a loss by weight of nearly 6 per cent. When treated with weak (5 per cent) hydrochloric acid, there was a strong effervescence, carbonate of lime and magnesium probably being the principal solubles in this case. The portion treated first with water and then with the acid showed a loss of 4 per cent in the acid treatment, and a combined loss of 10 per cent. The sample used was from the lower slope from a hole or cave-in which will be mentioned later. The sample is fairly typical of that taken from the borrow pits on the mesa.

In 1921 the maximum storage in the reservoir at any one time was 9,770 acre-ft., or a gage height of 65; the zero point being the lip of the inlet-well to the tunnel, or El. 4840 on the drawings. In the winter of

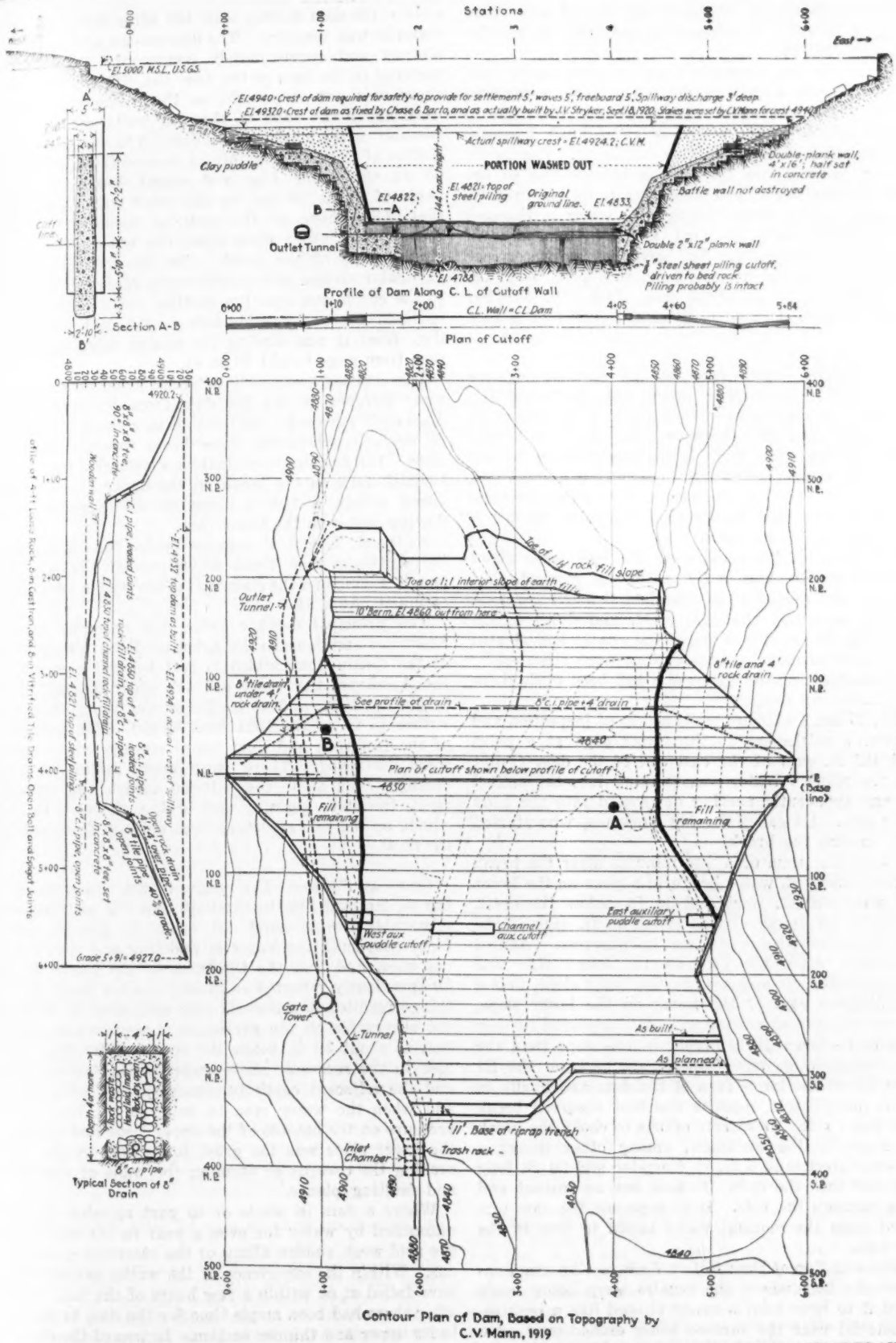

Stations
East
El. 5000 M.S.L., U.S.G.S.
El. 4940 - Crest of dam required for safety to provide for settlement 5', waves 5', freeboard 5', Spillway discharge 3' deep.
El. 4937.0 - Crest of dam as fixed by Chase & Barto, and as actually built by J.V. Stryker, Sept. 18, 1920. Stakes were set by C.V. Mann for crest 4942.0
Actual spillway crest - El. 4924.2; C.V.M.
PORTION WASHED OUT
Clay puddle
El. 4822
El. 4821 - top of steel piling
144' max. height
Original ground line
El. 4833
Double-plank wall, 4' x 16', half set in concrete
Battle wall not destroyed
Outlet Tunnel
Double 2" x 12" plank wall
El. 4788
1/4" steel sheet piling cutoff, driven to bed rock. Piling probably is intact
Profile of Dam Along C. L. of Cutoff Wall
C.L. Wall = C.L. Dam
Section A-B
Plan of Cutoff
Toe of 1:1 rock fill slope
Toe of 1:1 interior slope of earth fill
Outlet Tunnel
10' Berm, El. 4860, cut from here
8" tile and 4' rock drain
8" tile drain under 4' rock drain
See profile of drain
8" C.I. pipe + 4' drain
Plan of cutoff shown below profile of cutoff
Fill remaining
Fill remaining
East auxiliary puddle cutoff
West aux. puddle cutoff
Channel aux. cutoff
Gate Tower
Tunnel
As built
As planned
11'. Base of riprap trench
Inlet Chamber
Trash rack
Typical Section of 8" Drain
Contour Plan of Dam, Based on Topography by C.V. Mann, 1919

FIG. 2—PLAN OF APISHAPA DAM, WITH PROFILES ALONG CUTOFF WALL AND ALONG THE MAIN UNDERDRAIN

1921-22, 5,000 acre-ft. of water was carried over. This was used in 1922. The reservoir was dry during the winter of 1922-23.

Storage in the reservoir began in the spring and reached a gage height of 66, when some water was withdrawn; it was again allowed to rise, this time to a gage height of 76, where it stood until Tuesday, Aug. 20, when it began to rise still more. The valves were at full opening for sixteen hours prior to the break, discharging at an estimated rate of 2,500 sec.-ft. The rains and cloudburst caused the water to rise and fall somewhat until the 23rd, when an unusual rain caused such a rise in the Apishapa that the water rose in the reservoir to gage 83.1 ft. at 3 p.m., Aug. 23. The spillway level is about gage 84.2 (El. 4424.2), though there is a small channel a fraction of a foot lower.

The Failure—There were at the dam during the week of the failure about thirty men, including Mr. Knowlton, an engineer-contractor and a landowner in the project, and Mr. Dallimore, the engineer of the system. These men were being employed in miscellaneous work but particularly in repairing a small leak near the west end of the dam and in filling in some settlement areas and cracks near the point marked *B* on the plan shown herewith.

At 2:45 p.m., the repairs on the leak were about completed and the leak at this point was stopped. Mr. Knowlton had walked across the dam at about 1 o'clock, carefully observing the dam crest, and down to the water edge to see if any additional cracks had started or any settling or subsidence. None were observed by him, and except where the repairs had been made there was no apparent danger.

At 2:45 Mr. Dallimore made a trip of inspection and observed a settlement at the water edge at a point about 100 ft. west of the east end of the dam (Point A of the plan). Water was running into the settled area and apparently passing downward into the body of the dam. He called for his workmen, who started to try to stop the break.

At the same time or a few minutes after the break was first observed, water began to appear on the lower slope some 500 ft. west and 30 ft. below the crest. This point [*B* on plan] was about 60 ft. east of the point where repairs had been in progress. Almost immediately after the leak on the lower side was observed, wet spots appeared on the lower slope, first a short distance east of the break on the lower slope, and then in rapid succession wet spots appeared further to the east, each a little higher in the slope than the last. The flowing water rapidly ate back on the fill diagonally up the lower face of the dam and finally to a point immediately opposite the first observed break in the water side. Desperate efforts to choke the break were made by the workmen; among other things a galvanized steel tank 6 ft. in diameter and 20 ft. long was rolled into the hole. It held but an instant and passed through the hole. It is apparent the dam was doomed from the moment water began to flow in the lower side.

Cavities in Top of Dam Before Failure—An examination of the hole where the repairs were being made showed it to have been a cavity shaped like a beehive, the material near the surface being arched over. No distinct line of saturation was observable on the two ends of the dam as they were left after the break. The material was very dry. The laminations of the fill were distinct and approximately horizontal. Whether the material in the base of the dam was different from that above was not observable, as the portions remaining were above the edge of the cliff walls and less than one-half of the height of the dam. The wet area on the section of the dam remaining appeared from about gage 65 on the water face and sloped downward at an angle of about 30 deg. to the cutoff wall. Below the center line none of the material seemed to be wet from causes other than from the out-rushing water at the time of the break. On the westerly end in particular no line of saturation was observable, leading to the conclusion that the cavities did not have water in them for any considerable length of time, and if they filled it was during the period when the water rose from gage height 76 to 83.

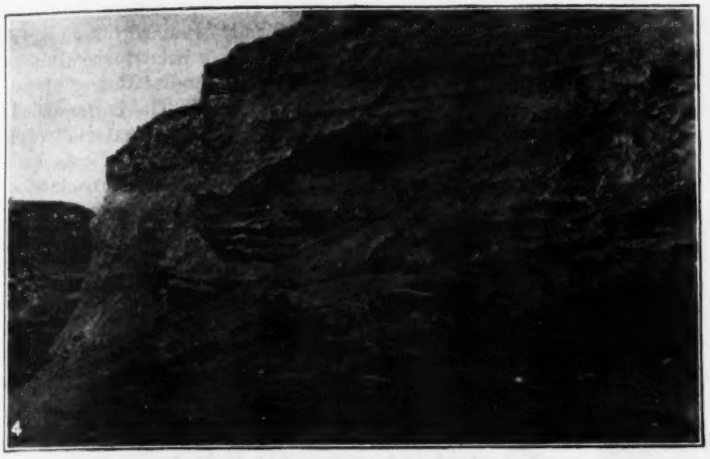
The cavities apparently extended from near point *A* some distance within the dam from the upper slope diagonally across the center line to a point nearly 400 ft. westerly, where the water broke through the lower slope. The cavities were doubtless connected by a longitudinal crack as the break on the upper face was followed within a few minutes by the appearance of flowing water on the lower face.

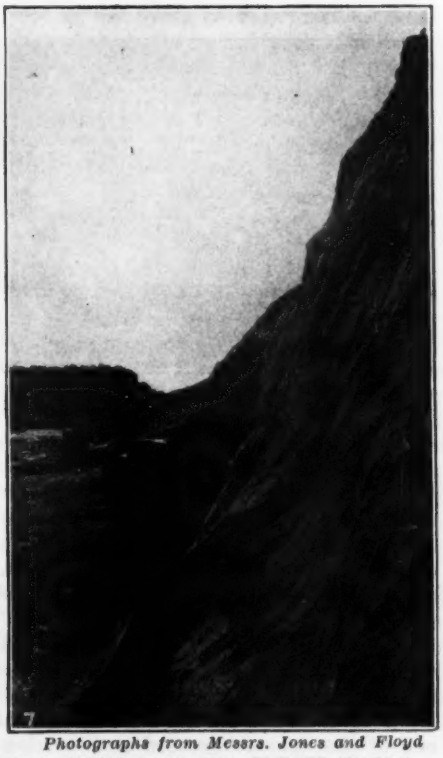
At the A. T. & S. F. railroad bridge the discharge of the Apishapa was about 60,000 sec.-ft., from 10:45 p.m. to 1 a.m., and the river was again within its channel at 9 a.m., Aug. 24.

The principal damage below the reservoir was to headgates and dams in the Arkansas River, though even at the Catlin dam, which is just below the mouth of the Apishapa, the water did not reach the 1921 flood height by 3 ft., and at La Junta was reported as not within 15 ft. of the 1921 flood height. The headgates of the Holbrook and Fort Lyons storage intake canals were destroyed. There were many minor cases of damage, such as to the railroad bridge and embankment, the state highway and bridge, the west half of which, an old pile structure, was entirely destroyed by the flood.

Cause of Failure—The results of the observations of the writer lead him to conclude that the material was unsuitable for an earth fill, especially for the upper face; that sufficient water in puddling and rolling was not used, and that the thickness of the layers of the fill [previously reported as 12 in.] was too great. These things resulted in a considerable settlement in the dam not observable on the surface, and a cavernous condition at about 30 ft. below the crest. When the water rose in the reservoir above gage 76, the caverns filled and the adjacent earth became saturated with water, and when the water rose to gage 83 the hydrostatic pressure on the outside of the upper slope and inside of the lower slope was too great to be held by the shell arching the caverns or forming the walls of the crack and faulting planes.

Where a dam in whole or in part remains dry and untouched by water for even a year in the dry air of the arid west, sudden filling of the reservoir is dangerous. Within the experience of the writer several dams have failed at or within a few hours of the first filling, after there had been ample time for the dam to dry out in its upper and thinner section. In two of the cases a considerable percentage of solubles was in the fill mate-





Photographs from Messrs. Jones and Floyd

FIGS. 3 TO 7—EAST AND WEST ENDS OF STANDING PORTIONS OF APISHAPA EARTH DAM AND CUTOFF WALLS

3. Bluff and remaining portion of each end of dam showing layers as placed, each about 1 ft. thick.
4. Close-up of material in upper portion of east end showing rolled layers more clearly than does (3).
5. Remaining portion of west end. Note large wet spots along bluff. In left foreground may be seen some of lower part of upstream portion of dam left in place after the failure.
6. Close-up view of west end looking downstream.
7. Near view of earth fill and cutoff wall at west end.

rial. Particulars [sent by wire at our request—EDITOR] follow:

Lyman Dam, Arizona, failed the day after the first filling on account of poor material and construction in the closure section. Solubles were present in this material.

Terrace Dam almost failed. Its upper part was wagon fill. This dried, settled and cracked, permitting water to reach sand layers below, placed by hydraulic sluicing.

Antlers Dam failed in 1899 after a hole had formed similar to the one in the Apishapa dam. The Antlers Dam had been raised and failed shortly after first filling.

Jumbo and Horse Creek dams failed by piping [?] on shallow bedrock before they had been in full use more than a year.

Dry Creek Dam, 15 ft. high, failed at the first filling. It had gone through one summer empty.

Unequal settlement due to varying heights, especially where there are abrupt changes in profile, cause shearing planes. These remain open while the fill is dry but when the water rises suddenly it flows along the shearing planes.

Every earth dam should be regularly inspected by competent observers, and the inspection should not be left to the watchman or to any one other than the engineering force.

* * *

Further Report on Apishapa Dam Failure

BY BARTON M. JONES AND O. N. FLOYD

Engineers with the Dayton Morgan Engineering Co., Pueblo, Colo.

A BRIEF account of the failure of this dam was given by the authors of this article in *Engineering News-Record*, Aug. 30, 1923, p. 357, to which the reader is referred for details not here repeated. The type of failure is unusual and its exact cause is somewhat puzzling. It is evident that more than ordinary care was exercised to obtain a good job, yet the dam failed suddenly and almost without warning with the water 10.5 ft. below the top, where it was being held by the discharge through the outlet tunnel.

The construction of the Apishapa dam is described in *Engineering News-Record* for June 16, 1921, p. 1030,

FIG. 8—HOLE IN DOWNSTREAM FACE OF APISHAPA DAM

Caused by leak through horizontal seams in sandstone of west canyon wall. The text indicates that this had nothing to do with the failure of the dam.

by Clair V. Mann, resident engineer. The dam is described as having been constructed to a height of 112.2 ft. A cross-section (reproduced in *Engineering News-Record*, Aug. 30, 1923, p. 357) shows that originally a height of 120 ft. was intended. Lack of funds prevented the completion to this height. The riprap was likewise carried up 60 ft. in elevation above the toe instead of to the top. The cross-section also indicates that the downstream one-fifth of the dam was made of coarse material. There remains at the east end of the dam an exposed cross-section about 45 ft. high and at the west end a section probably 60 ft. high, and there is no visible evidence that the material in the downstream fifth is any different from that in the other portions of the dam at the same elevation. From our observations at the site and information obtained from those familiar with the work it appears that in all other respects the dam was constructed substantially as shown on the cross-section mentioned.

Leaks—At different times in the past when the water in the basin reached within about 35 ft. of the top of the dam small leaks occurred through the rock underneath each end of the dam. Because of a recurrence of these leaks and the rapid rate at which the basin was rising as a result of heavy rains at the Apishapa headwaters, A. N. Dallimore, chief engineer, and H. H. Knowlton, secretary-treasurer of the Apishapa Consolidated Irrigation Co., owners of the structure, were at the dam for some time before the failure with a force of about 40 men and some teams. Messrs. Dallimore and Knowlton are both graduate engineers and have been connected with the project since construction started—Mr. Dallimore in charge of the outlet structures and concrete and Mr. Knowlton in his present capacity. We are indebted to these men as eye-witnesses for a description of the failure and for information concerning the construction of the dam.

The small leaks had all been stopped or reduced to a harmless flow when the big leak that destroyed the dam started. There seems to be no question but that an open crack had formed diagonally through the dam from the upstream slope at the east end to the downstream slope near the west end. It hardly seems possible that such a crack could have been formed unless a large portion of one of the toes had settled or moved.

Composition of Original Material—The bottom 60 ft. of the dam was built of sandy adobe material taken from the river valley while the top 50 ft. was built of a light brown finely powdered material containing sand and gravel from high ground east of the dam.

There were probably 5,000 or 6,000 cu.yd. of the lower material left in the upstream portion of the dam at the east end, but practically none was left in the downstream portion, although a number of large masses of it had been washed down the valley [i. e., en masse (?) EDITOR]. Wherever this material was found it appeared to be damp throughout and resembled very much the outer edges of the core of a hydraulic-fill dam when exposed by a washout from the core pool.

Extent of Saturation—The light brown material in the upper part of the dam was very dry, so dry that whenever a small portion of it would scale off the nearly vertical exposed face and slide down to the river below a noticeable cloud of dust would rise. Each rolled layer was plainly visible. The top 2 or 3 in. of each layer was very hard, somewhat resembling soft shale. The rest of the layer, while fairly compact, could readily be dug out with a stick. At one place a quantity of this material had caved and fallen on a dry ledge of rock. It resembled road dust except for the small amount of gravel and slabs of the hard layers. In walking over this dry material, pulverized by the fall, one's feet would sink into it 6 to 8 in. This material apparently gave a very impervious fill. On the upstream slope of each exposed cross-section the line to which the water had penetrated could be followed for a distance down of 20 to 25 ft. in elevation from the water surface. At the lower depth the water had gone into the fill only 5 or 6 ft. Aside from some wet spots where leaks occurred from seams in the canyon walls this upper part of the dam appeared to have remained remarkably dry.

It seems likely that the material in the bottom 60 ft. of the dam became saturated or at least damp throughout and settled more or less, causing a slight movement in the downstream toe.

Cracks and Settlement—We were told that about a year ago a crack developed in the upstream face near the top of the west end and extended for some distance diagonally across the crest toward the east downstream slope. This crack was above the water in the basin at

the time. It was filled and puddled and gave no further trouble. It may be noted that this crack was symmetrically located, but crosswise to the crack that resulted in the failure.

The nature of the material in the top 50 ft. of the dam is such that cracks would be expected to develop in case of any appreciable uneven settlement. There may have been some tendency for this hard dry material to arch the 300-ft. rock canyon and crack, for certainly the rock shoulders of each bluff would prevent it from readily adjusting itself to settlement of the material below. The material in the bottom 60-ft. portion was quite probably somewhat susceptible to saturation and consequent settlement and spreading. The water could all have entered it through the upper slope, but on account of the drainage system in the downstream slope and the high tailwater in the valley below, resulting from the heavy outlet discharge, some water may have entered directly into the downstream portion.

Underdrainage—The drainage system for the lower toe is shown in the cross-section already mentioned. We were told that these drains had shown some flow of clear water after the basin began to fill and that this flow increased slightly with the increased head. Before the failure, for several hours, these drains had been covered with backwater from the outlet tunnel, but before they were covered the discharge was clear and was estimated to be about 1 sec-ft. There was nothing to indicate that the flow underneath the dam contributed in any way to the failure.

Leakage Through Seams in Canyon Walls Not Cause of Failure—The dam contained a dangerous element of weakness. It caused trouble to develop, but this damage was repaired. It is fairly certain that the failure was independent of this weakness, although the symptoms were such as might lead to a failure. Water reached the portion of the fill downstream from the concrete cutoff wall through horizontal seams in the sandstone formation of the canyon walls. This was clearly seen in the saturated appearance of large spots in the face of the fill that remained at the west end of the dam. These spots were at the same elevation as the visible seams in the rock. Small leaks in the fill, no doubt from this cause, had been plugged and considered safely repaired prior to the failure. This was observed at both ends of the dam, in the portions remaining that were not affected by the failure.

Effect on Steel Cutoff Wall—The narrow canyon just below the dam was filled to a depth of about 25 ft. with material from the dam. This filling tapered out until it was hardly noticeable at a point 1,200 to 1,500 ft. below the dam. A small rim of the upstream toe covered with the riprap to an elevation of 25 to 30 ft. above the original creek bed was not washed out and its straight lines show that it had not moved. It is likely that the scour in the base of the dam reached bedrock during the heavy discharge and that this hole had been filled with material carried by the later smaller flow.

A steel sheet piling cutoff about 300 ft. long joined the concrete cutoff walls at each bluff. The piles were reported to be from 25 to 33 ft. long and their tops were at about the elevation of the old river bed. A thousand feet or so below the dam we found a portion of these piles. Although they were badly bent and twisted they were hanging together. Thirty piles were exposed but others probably were under the earth that had been washed downstream. Those we saw were Carnegie sheet piling, 38 lb. per ft. It is possible that the entire steel cutoff was torn out. The concrete cutoff walls remain intact.

It was interesting to see the amount of silt that had been deposited in the basin above the dam. Although the dam was only finished in September, 1920, the old creek channel was entirely silted up and on the valley floor there was a deposit from 6 to 8 ft. deep.

Gage Height and Flood Down the Valley—The fight to save the dam was abandoned at 3:00 p.m. The gage was read at 3:45 and at each 15-minute interval until 4:45 when the water in the basin was below the gage. The accompanying table shows the readings and the discharges which they represent.

Time P.M.	Gage, Ft.	Total Fall, Ft.	Storage, Acre-Ft.	Discharge, Acre-Ft.	Average Rate of Discharge, Sec.-Ft.
3:00	82.9	....	18,500	....	....
3:45	81.0	1.9	17,400	1,100	18,000
4:00	79.8	3.1	16,000	1,400	68,000
4:15	70.0	12.9	11,700	4,300	208,000
4:30	55.0	27.9	6,700	5,000	242,000
4:35	51.0	31.9	5,600	1,100	160,000
4:45	42.0 *	40.9	3,600	2,000	145,000

* Bottom of gage.

The basin was seven miles long and rather narrow so that the slope of the water surface must have been considerable during the last few readings. This would indicate an exaggerated drop in gage and storage and consequently the later rates of discharge would be somewhat too high.

The flood water reached a point down the valley eleven miles below the dam at 5.20 p.m., according to one man and 5.30 according to another one near by. At this time there was quite a large flow still passing the dam site and the total length of the moving body of water must have been fifteen to eighteen miles. As the deepest water was near the lower end it would tend to get longer rather than shorter. This, together with the valley shortage, seems to account for the small depth of the flood wave and its low rate of advance. However, in determining the rate of the flood wave it would probably be more accurate to count from 4 rather than from 3 o'clock as the flow prior to 4 o'clock was comparatively small. This seems to be borne out by the fact that the flood wave reached the railroad bridge at the mouth of the river near Fowler 35 miles below the dam at 8 o'clock or traveled the last 24 miles in 2½ hours or at the rate of about ten miles per hour.

At this railroad bridge the valley is more than a mile wide while the bridge opening is probably not over 350 ft. long. The railroad embankment across the valley is from 10 to 15 ft. high and it formed a retarding basin which reduced the maximum flow that entered the Arkansas to 50,000 sec.-ft. or less. The flood wave down the Arkansas River was slow and more or less harmless. It reached Las Animas about fifty miles below the mouth of the Apishapa River at 11 o'clock the next morning and produced a rise of only 5 or 6 ft., while the maximum rise there occurred about two hours later.

Drainage Downstream—No loss of life was reported. One set of farm buildings was flooded 8 to 10 ft. deep and damaged considerably but not destroyed. These buildings were 11 miles below the dam and the farmer had been warned in time to get his family out about twenty minutes before the water arrived.

The two diversion dams of the project were not seriously damaged but the canal banks were overtopped

and broken at a few places. A few highway bridge approaches were washed out. The flood washed around the diverting dam of the Ft. Lyon canal about three miles west of La Junta and around the headgate of the Holbrook canal on the north side of the Arkansas, eight miles west of Rocky Ford.

Conclusion—It is apparent that this failure was not the result of carelessness or slighted work. It was not related to outlet or spillway structures inasmuch as these were separated from the dam and were not affected. We suspect that more water could have been used to advantage in rolling the material that came from the high ground, although we found no reason to consider this defect as a factor in the failure.

Our principal criticism of the dam as a whole is that the narrow rock canyon is not a desirable site for an earth dam. This criticism might be modified in case of a hydraulic-fill dam on account of its almost total freedom from settlement, but even then there would remain the uncertainty of maintaining a water-tight joint between the earth fill and the rock walls.

The failure was in the body of the dam, through a diagonal crack believed to be the result of unequal settlement brought about by subsidence and movement in the bottom portion of the dam. Eye-witnesses say they saw the water flow longitudinally through the dam in the diagonal crack and that neither extremity reached an abutment. This fact would eliminate theories that the failure originated from trouble at either canyon wall.

Engine Terminal Design, Capacity and Equipment

Track Layout and Enginehouse Leads—Rectangular and Circular Enginehouses—Turntable Capacity—Coaling Plants

Abstract of report of Committee on Design of Shops and Engine Terminals, presented at the annual meeting of the Mechanical Section of the American Railway Association.

Terminal Design—Engine terminals must be laid out so that each operation will not interfere with another. This requirement cannot be overemphasized. Few operations can be conducted efficiently for any length of time if the facilities are strained to the limit. To this end each facility should be designed to perform double the work ordinarily required and at important terminals duplicate facilities should be provided.

A single-track lead to an enginehouse is inexcusable. With three or more tracks available a majority should be assigned to incoming engines. Sufficient leads, switches and crossovers must be provided to avoid delays at coaling station, ash pit, inspection pit or other facility. As a general rule a number of short leads are preferable to a single long lead, as the former arrangement enables one engine to move independently of others. Where the number of leads is restricted, frequent crossover switches should be provided to prevent blocking any locomotive. The lead track to turntable should line up with corresponding tracks in enginehouse for convenience in placing dead engines.

Enginehouse Design—Modern enginehouses are divided into three classes: (1) brick wall with wood frame and roof; (2) reinforced-concrete frame and roof; (3) a combination of steel frame and reinforced concrete. The first is cheapest and most generally used, but the trend has been toward reinforced concrete. Enginehouses should be of fireproof construction as far as possible. Provision should be made for doubling the capacity needed, but it is first necessary to determine the class and extent of repairs to be made.

It is desirable to locate the house some distance from a city in order to get cheaper land, but it must not be too far away from an adequate labor market. The number of stalls to be provided is a function of the engines to be handled and the expected detention. If 100 engines are to be cared for and each may occupy a pit twelve hours, then fifty pits will be needed. If the average detention is only eight hours a day then thirty-four stalls will be ample. Quality of water (as affecting boilers) and amount of local switching may also exert considerable influence upon the number of stalls necessary.

Enginehouses are made in various cross-sections to suit local conditions, facilities, funds and tastes. Columns may be omitted in the drop pit section and trusses substituted. This provides a clear passage for moving wheels from the pits to the rear of the house. The outer row of columns should be made strong enough to support jib cranes, which may then be installed at any time desired. The modern house for a large terminal may have an overhead crane, down-draft ventilation system, boiler-washing plant, drop pits for driving, engine truck and tender wheels, jib cranes at frequent intervals and many other facilities. Practically all of the later enginehouses have increased head room to improve ventilation and lighting. The continuous monitor type of house, single or double, is now being more generally adopted. On several large roads the depth of the house has increased to 132 ft. The rear wall or outer circle wall should be practically all windows, with window sills about 4 ft. from the floor.

A rectangular enginehouse may fit the shape of the property better than a roundhouse. For large stations a transfer table may be located between two transverse rectangular enginehouses and some rectangular layouts will require both a transfer table and a turntable. In a rectangular house a transverse track arrangement is preferable to a longitudinal arrangement. The rectangular house, owing to its parallel spacing of pits, is easier and cheaper to build than a roundhouse. One particular advantage of the rectangular house with a wye track is the saving in space permitted inside the building on account of the parallel track arrangement. Leads and wye tracks cost less to maintain than turntables.

Turntables—Turntables are generally 100 to 110 ft. long, and 120-ft. length is being used for large engines. All turntables should be equipped with suitable tractor or tractors. One turntable is ordinarily sufficient for a 50-stall enginehouse. Such a house would provide for despatching 100 engines per day if each engine was detained in the house an average of twelve hours a day. This would mean 200 moves of the table daily, if each despatchment required two moves, one in and one out, and if all engines were despatched. In other words, the table must turn once every 7.2 minutes. If a peak load period occurs in which 25 per cent of the movements are made in four hours, this would require the table to turn once in every 4.8 min., which is about as fast as dependable operation will justify. Another consideration is the delay on account of failure of power or table, which in some cases may justify more than one table for an enginehouse with less than fifty stalls.

The size of the turntable has a considerable bearing upon the number of stalls in the house, and longer tables permit more track approaches without having frogs in the track at edge of table. Generally, the longer the table the less waste floor space at outer circle of house, owing to reducing the angle of stalls. The turntable should be long enough to balance the engine when tender is empty. A deck turntable is preferable to a through type with shallow pit, when the cost of construction is not greater and when drainage will permit.

Coaling Stations—The type selected usually depends upon the number of engines handled, the number of tracks available for coaling engines and the kind of coal used. Station capacity should be at least a 24-hour supply and better 48-hour for maximum demand. The coal storage bins should be made self-cleaning as far as possible by proper sloping of floors. Gravity tipple outlet fixtures may be of the under-cut or over-cut type, but the over-cut fixture seems to provide more even mixing of coal delivered.

Mechanical coaling stations should be of the transverse type and a station serving several tracks is preferable to the longitudinal type because it facilitates engine movement to and from the station. When it is necessary to deliver coal to two or more tracks it is best to install a mechanical type of station. Loaded coal car tracks should have a down grade toward the track hopper to permit easy feeding of cars. The receiving hopper must be long and wide enough to handle a complete car and provide sufficient room for unloading and handling coal. The hopper should be protected from the weather. It is not good practice to have a steel coal chute too close to the ashpits, on account of fumes from wet ashes corroding the steel. A good many modern mechanical stations are built of concrete and have bucket conveyors. Under certain conditions a belt conveyor has been found satisfactory and economical. A coal measuring or weighing device is recommended for all coaling stations.

A longitudinal coaling station designed recently has the coal dumped into a pit below the ground level and a traveling crane with grab bucket lifts the coal to gravity chutes which deliver direct to tenders. This type of coaling station has a number of new features which may prove superior to other types in operation or economy.

Movement of B. Coli in Ground-Water and Pollution of Wells

Abstract of part of the 1922-23 annual report of the Board on Excreta Disposal, presented to the Conference of State Health Officers May 17, 1923, by C. W. Stiles, Professor of Zoölogy, Hygienic Laboratory, and Harry R. Crohurst, Sanitary Engineer, U. S. Public Health Service; slightly condensed here from the Public Health Reports, June 15, 1923.

IN CONNECTION with investigations by the United States Public Health Service into methods of disposal of privy wastes in rural districts, extensive and rigorously controlled experiments have been made which bear upon the movement of fecal bacteria in the ground-water. These studies have involved the experimental pollution of the ground-water (namely, the water in the saturated zone, which supplies wells and springs) and have been correlated with the rise and fall of the ground-water table, the flow of ground-water, and the rainfall. Natural can material (human excreta from can-type privies) was used as pollution material. B. coli was taken as the bacterial test, and a dye (uranin) was utilized in tracing the movement of the water from the dosing trenches to the more than 400 experimental pipe wells which were arranged at intervals from the trenches and at various depths into ground-water.

The examination of thousands of water samples from the wells during a period of more than a year has resulted in the following data regarding the movement of bacteria in sand:

1. Pollution with fecal B. coli has up to date been definitely and progressively followed in the ground-water for distances of 3, 6, 10, 15, 25, 35, 45, 50, 55, 60, and 65 ft. from the trench in which the pollution was placed; uranin has been recovered from these same wells and has spread to other wells at 70, 75, 80, 85, 90, 95, 100, 110, and 115 ft. from the pollution trench. The soil in question is a fine sand with an effective size of 0.13 millimeters.

2. The pollution has traveled these distances within a period of 187 days, or about 27 weeks, and only in the direction of the flow of the ground-water; no convincing evidence is present that the pollution has traveled against the flow of the ground-water or at right angles to it.

3. The pollution has traveled only in a thin sheet at the surface of the zone of saturation; there is no evidence at present that it has dispersed radially downward, and even when heavy pollution is recovered at the top, water from lower levels (in near-by deeper wells) is negative both for uranin and for B. coli.

4. As the ground-water level falls, owing to dry weather, the pollution tends to remain in the sand above the new (lower) ground-water level, namely, in the new capillary fringe.

5. There is no evidence which would justify a conclusion at present that either the bacteria or the uranin is carried or moves to any appreciable distance in the capillary fringe itself, and there is neither theoretical reason nor experimental evidence to justify a conclusion that either the bacteria or the uranin progresses in the dry, aerated intermediate belt (between the capillary fringe and the upper soil belt). All present evidence is to the effect that when the ground-water level falls the pollution remains practically stranded in the capillary fringe or in the intermediate belt—according to the degree of fall of the ground-water.

6. A rainfall of 1 in. results in a rise of 5 to 6 in. in the ground-water table (in the particular experimental area in question); and if this rise is sufficient to re-establish the zone of saturation up at the level of the stranded pollution, the bacteria and the uranin are again picked up and carried along farther in the direction of the ground-water flow until dry weather again intervenes to cause another fall of the ground-water level.

7. Thus the progressive (passive) movement and the stasis (stranding) of the pollution are intimately connected with, are dependent upon, and alternate with the rise and the fall of the ground-water level, and this latter factor is dependent upon the alternation of wet weather (rainfall) and dry weather (lack of rain at the intake area of the ground-water table). Experiments are now under way to determine, if possible, whether pollution placed directly into a deeper level of the ground-water will travel up to the surface of the saturated zone.

8. In explaining these results, capillarity, filtration, and gravity seem to come up for special consideration.

9. In one experiment the pollution traveled only 45 ft. from September, 1922, to May, 1923, and remained stranded at this distance. Study of the formation of the ground revealed that under the belt of pollution there is an impervious or nearly impervious stratum of peatlike material, which gradually tilts upward distally from the pollution pit and forms a ground-water dam; the pollution traveled out on high ground-water to the dam, the ground-water level fell below the crest of the dam, and the pollution is now stranded, pending a rise of the ground-water table sufficient to produce a ground-water cascade which will carry the pollution over the crest of the dam.

10. The ultimate distance to which the pollution will be carried is dependent upon a number of complex and interlocking factors, namely, wet and dry weather, with resulting rise and fall of the ground-water; the length of each of these periods; the rate of the ground-water flow (depending upon the "head," which, in turn, is dependent upon the rainfall); and, obviously, also the factor of the viability of the organisms under conditions of moisture, pH, food supply, etc., *ad finem*.

11. In another series of experiments human feces were buried in pits, in a locality of high ground-water, and covered with sawdust. Of five samples taken three years and two months after burial all were both macroscopically and microscopically recognizable as feces, but the odor had become somewhat musty; three of these samples were positive and two were negative for B. coli; ova of *Ascaris lumbricoides* were recognizable in all five samples, but all 57 ova found were dead.

12. The bearing of the foregoing results upon the intermittent pollution of wells, the location of water supplies, and the location of camps in peace or in war will be evident to persons who are called upon for technical advice in these matters; the justification of the laws forbidding the use of abandoned wells for the disposal of excreta is self-evident; the possible effect of the custom (in some localities) of digging pits into ground-water (as advised by some persons) is obvious.

13. In protecting wells, special attention should be given not only to surface protection, as is now generally recognized, but also to a new element, namely, the danger zone which exists from the highest water level to about a foot below the lowest water level. A leak in the pipe in this region is potentially very dangerous, and all wells unprotected in this danger zone are to be considered as potentially unsafe.

Deferrizing Additional Water Supply of Berlin

Aeration Followed by Rapid Passage Through Gravel Beds and Sand Filters Removes High Iron Content of Ground Water of Additional Supply for German Capital

By Gordon M. Fair
Instructor in Sanitary Engineering, Harvard University, Cambridge, Mass.

DEFERRIZATION is one of the most important problems of water supply in the glaciated areas of middle Europe. German engineers have solved it in a variety of ways, among which the methods used for the purification of the additional water supply of Berlin present numerous departures from common European practice. The extension of the water-supply system of the German capital was completed just prior to the outbreak of the Great War. As a result, it is little known and has since completion not even been described in the German technical journals. The present description of the plant is based upon observations made by the writer when he visited the works, supplemented by information just received from one of the plant engineers, who furnished the writer with the illustrations.

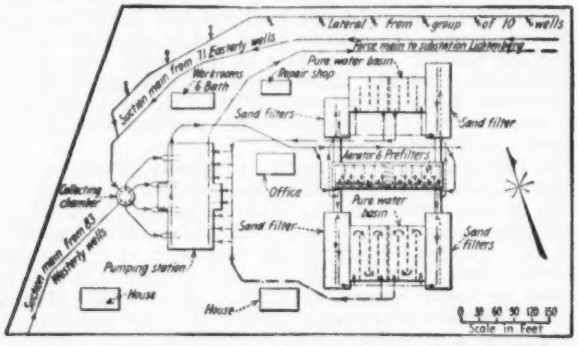


FIG. 1—GENERAL PLAN OF PUMPING STATION AND DEFERRIZING PLANT OF BERLIN WATER-WORKS

Sources of supply—The central city of Berlin, with a population of about 1,500,000, obtains its water supply from three sources, all of which require treatment for iron removal. The oldest collecting and purification works still in operation were built in 1877. This plant, situated on Lake Tegel about seven miles from the heart of Berlin, has a capacity of 17.5 to 23 m.g.d., the maximum demand occurring during the summer months. The supply is obtained from wells driven along the lake shore. The iron bearing water (1.2 to 3.4 mg. Fe per liter) is aerated prior to slow sand filtration. In 1893 a second plant, with a capacity of 64 m.g.d., was put into operation on Lake Müggel about eleven miles from the city. It derives its supply from three different sources. The bulk of the water is obtained from driven wells intercepting the underflow towards the lake. This water, containing 1.1 to 2.9 mg. Fe per liter, is purified by aeration and slow sand filtration. From 10 to 20 per cent of the supply is drawn from Lake Müggel itself and purified by slow sand filtration alone. About 5 m.g.d. are pumped from the lake on to large sandy areas whence the water percolates into the ground to increase the well water. In 1910 the rapid growth of Berlin necessitated the construction of a third plant, which was completed in July, 1914.

The new plant is situated about seven miles east of Berlin in a forested area about three square miles in extent, known as the "Wuhlheide." The region is traversed by the sandy bed of an ancient glacial stream whose modern progeny is the much smaller river Spree. The bank of the ancient river bed, rising 150 ft. above the plane, forms the catchment area of the ground water flowing towards the Spree. The water is intercepted by means of 154 wells that parallel the river and yield from 6 to 17 m.g.d. The highest demand is made upon the plant during the four summer months, when it delivers 17.2 m.g.d. to the city; the lowest demand occurs during the three winter months, when the pumpage sinks to 5.7 m.g.d. During the five spring and fall months, 11.5 m.g.d. of water are used. The water contains relatively large amounts of iron which is removed by aeration and double filtration. The pumping station and purification works are situated in the center of the well field. A general plan of the plant is shown by Fig. 1.

The Wells—The wells are driven at intervals of 80 to 160 ft. to a depth varying usually from 115 to 200 ft. The extreme westerly wells, in the driving of which heavy strata of clay were encountered, penetrate to a depth of 325 ft. A main conduit receives the flow of 83 westerly, another that of 71 easterly wells. The average daily yield of each well is 78,000 gal., the demand varying from 38,000 to 111,000 gal. The wells are connected in groups of six to ten that discharge through a metered branch line into the collecting main. The branches and individual wells can be closed off separately. The wells are constructed of seamless drawn copper tubing provided at the proper depth with a strainer whose slots are protected by copper screening. The collecting conduits are laid on a slope of 1 in 4,000 and lead to a receiving chamber situated in front of the pumping station. The diameter of the mains increases gradually from 8 to 43 in. The drop leg of the main leading into the receiving well is reduced to 36 in. Two rotary air pumps remove the air from the suction mains to start the flow of water and operate automatically in removing the gases discharged by the water, thus preventing interruption of flow.

Collecting Chamber—The collecting chamber, 26 ft. in diameter and 13 ft. deep, is constructed of brick walls built upon a heavy reinforced-concrete foundation. A cross-wall bisects the structure. Each collector main discharges into one of the compartments thus formed. A suction pipe from a low-lift pump enters each half of the collecting chamber. The two compartments communicate by means of gate-controlled openings in the dividing wall. It is possible to operate either half of the plant independently of the other. Electric indicators in the superintendent's office and in the pumping station record the water level.

Pumping Station—The pumping station, about 80 ft. from the collecting chamber, like the remaining build-

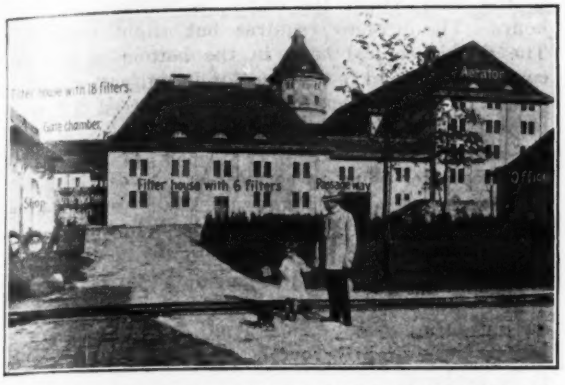


FIG. 2—VIEW OF BERLIN WATER DEFERRIZATION PLANT, LOOKING EAST

ings of the plant, is a reinforced-concrete structure finished on the outside in yellow-brown stucco with a red tile roof. In the construction of its foundation and waterproof basement the ground water level had to be drawn down over 20 ft. The main pumping-equipment consists of four sets of electrically driven raw-water and pure-water pumps of the double-acting plunger type. During the winter only one set is in operation; during the spring and fall, two; during the summer, three. The fourth set remains in reserve. The raw-water pumps operate vertically. They are situated in the basement of the building. The horizontal pure-water pumps occupy the main floor of the station. Each pumping set consists of a raw-water and a pure-water pump attached to a common shaft operated by a synchronous alternating-current motor. The capacity of each raw-water pump at 70 r.p.m. of the motor is about 6 m.g.d. The pure-water sister pump has a capacity smaller by 8 per cent to allow for wash water losses and other plant uses. When less than 8 per cent of the water is actually consumed, the excess is permitted to accumulate in the pure-water basins and is pumped from time to time to the city by means of two special centrifugal pumps. The raw-water pumps force the water through a common main to the aerators. The pure-water pumps take the treated water from the clear-water basins and force it through a 36-in. main to large storage basins in the substation "Lichtenberg" on the outskirts of Berlin, whence it is pumped under the requisite pressure into the distributing system of the city. Each pump is equipped with a suction and discharge air chamber. The main conduits are further provided with special air chambers 6½ ft. in diameter and 26 ft. high. Strong check valves are inserted in the 5.6-mi. force main to Lichtenberg to prevent flooding of the pumping station in case of a break of a main within the building.

FIG. 4—AERATOR NOZZLE IN OPERATION
A conical spray ascending at an angle of 60 deg. is obtained.

Aerators—Two aerating chambers are situated in the upper story of the pre-filter house (Fig. 2). The raw-water main runs the whole length of the building and branches into horizontal aerator feed pipes controlled by separate gates. Each feed pipe supplies 40 nozzles screwed into the pipe at 3-ft. intervals. The aerator nozzles (Fig. 3) are of the double-jet type. They have a capacity of 32 g.p.m. (46,000 gal. a day) and divide the water into a fine spray that falls within a radius of 8 ft. Fig. 4 shows one of the nozzles operating as a lawn sprinkler. Ventilators provide circulation of air through the falling water. The ferrous iron dissolved in the water is oxidized rapidly and precipitates. Hydrogen sulphide and carbon dioxide present in the water are removed at the same time.

Gravel Filters—The drops of the water from the aerator are caught upon ten prefilters or scrubbers situated beneath the aerating chambers (Fig. 5). The area of each bed is 442 sq.ft. (about 1/100 acre). The filtering medium is 24 in. deep and consists of gravel 6 to 10 mm. in diameter resting upon a false bottom of perforated copper plates. The gravel is arranged in two layers placed between copper screens to prevent its displacement during washing. The average rate of filtration is 168 m.g.d. per acre, with a filter period approximating 100 hours. When the gravel has become clogged with iron, the filter is washed by reversing the flow and introducing compressed air beneath the filter. The air is obtained from two five-step turbine blowers each capable of delivering 1,750 cu.ft. of air per minute against a head of 10 ft. of water. Distribution of the air under the filter is accomplished by means of a system of 2-in. pipes provided with ½-in. orifices. The coarse pre-filters remove about 50 per cent of the precipitated iron. The filtered water passes by way of an overflow to the sand filters situated in four buildings connected to the aerator house by covered passageways. The wash-water is conducted to two 26x130-ft. sedimentation basins, in which most of the iron sludge settles readily. The clear effluent from these basins flows through a ditch to the River Spree.

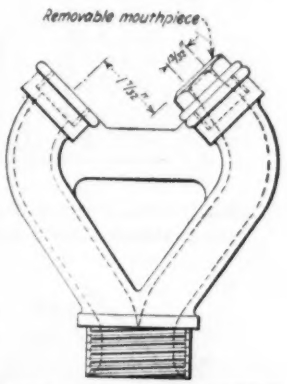


FIG. 3—AERATOR NOZZLE
Two impinging jets divide water into fine spray.

Sand Filters—There are sixty filters (Fig. 6), of the rapid sand pressure type, called "Bollmann" filters after their designer. Three of the filter buildings contain eighteen tanks each; the fourth has but six. The filters operate under a head of 10½ to 11½ ft. of water and each delivers on an average 317,000 gal. a day. The filtering surface is 67 sq.ft., the average rate of filtration therefore being 206 m.g.d. per acre. The initial rate approaches 240 m.g.d. The diameter of the filtering quartz sand is 0.8 to 1.5 mm.

Each filter tank (Figs. 7 and 8) consists of a steel shell 9 ft. in diameter and 8 ft. high, with a 4-ft. conical bottom, resting on cast-iron columns. The shell is closed water-tight with an arched cover. An air valve situated on the cover operates automatically when the filter is filled or emptied. The water enters at the top of the filter and flows over a distributing gutter on to the sand, passing through it to the underdrains. These are situated 5 ft. below the sand surface and

consist of 2-in. bronze laterals branching from a cast-iron main. The laterals are provided with fine slits $\frac{1}{16}$ in. wide and $\frac{3}{4}$ in. long cut into three-quarters of the circumference of the pipe, the unperforated quarter facing upward. The effluent pipe is arranged in the form of a gooseneck vented at the top to prevent siphonage. After a filtering period of 100 to 120 hours

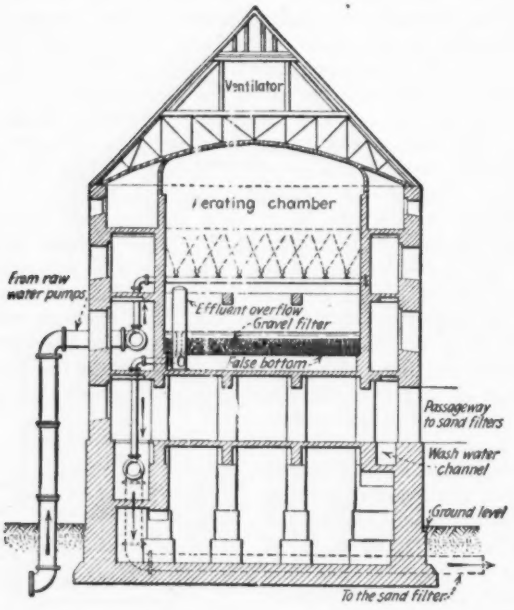


FIG. 5—AERATOR HOUSE AND GRAVEL PREFILTERS
The aerating chamber is only indirectly accessible to the air.

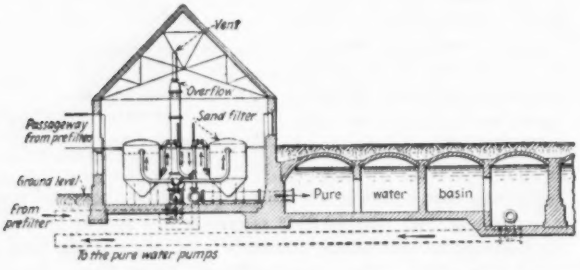


FIG. 6—RAPID SAND FILTERS AND PURE-WATER BASINS
The filters operate under a head of 11 ft.

the rate of filtration has commonly decreased to 144 m.g.d. per acre, when the filter is washed by reversing the flow for eight to ten minutes. This method of backwashing is effective for six to eight times, that is, for three to six weeks. A thorough cleansing of the sand grains then becomes necessary. This is accomplished by means of an injector situated at the bottom of the conical filter bottom. When the injector is operated the sand is sucked into the injector discharge and thoroughly scoured in its upward passage through a vertical tube situated in the center of the filter and rising above the sand surface. The washed sand (spec. gr. 2.65) falls on to the sand bed, the waste water carrying with it the lighter iron deposits (spec. gr. 1.18) flows over a peripheral wash-water gutter to the wash-water sedimentation basins used in connection with the prefilters. The sand content of the filter, about 160 cu.yd., is washed in 1 to 1½ hours. The process requires but slight supervision. The double conical body in the bottom of the filter conducts the sand to the injector in uniform quantities. The wash-water required does not exceed 2.2 to 2.5 per cent of the water filtered.

Some of the filters were opened in the writer's presence after being in service for 5½ years or longer. The sand was removed mechanically by means of the injector and sifted. The sand loss during the long period of operation, together with the sand discarded as having become too fine, amounted to 0.1 per cent of the filter contents. The sand was free from incrustation as was the shell itself. The bronze underdrains were slightly corroded and some of them had to be replaced.

Pure-Water Basins—The four pure-water basins (Fig. 6) have a combined capacity of 1.6 m.g. They are constructed of brick walls upon a watertight concrete floor. Each basin has three round-the-end baffles that prevent stagnation of the water. They are roofed over and covered with 40 in. of sodded earth. A water tower (Fig. 9), holding 80,000 gal., serves the suburb "Oberschöneweide."

Results of Operation—The raw-water delivered to the plant is colorless and, due to its high iron content,

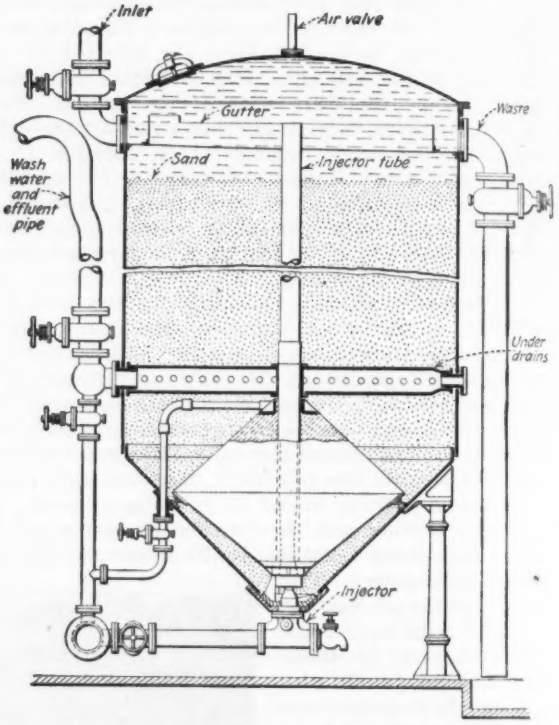


FIG. 7—CROSS-SECTION OF BOLLMANN FILTER
The sand is washed by reversing the flow of water through the underdrains. When this is no longer effective the injector at the bottom of the filter is used.

becomes opalescent on standing. It has a slight odor of hydrogen sulphide, is rather hard, but bacteriologically very pure. During five years of operation the iron content has increased from 4 to 8 mg. per liter, together with the other mineral substances. The sanitary quality of the water has remained unchanged. Aeration and filtration remove the iron and manganese

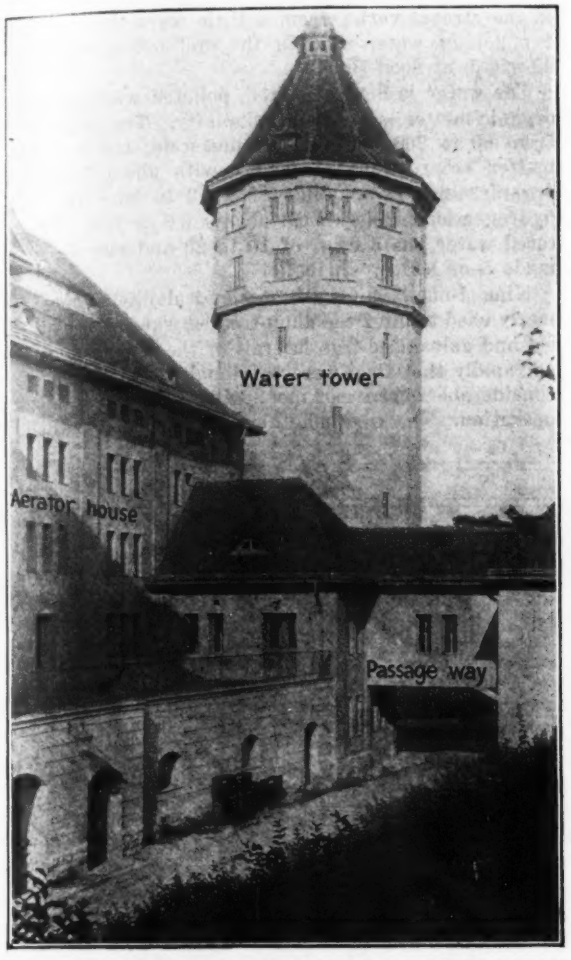


FIG. 8—ARCHITECTURAL TREATMENT OF WATER TOWER OF BERLIN DEFERRIZATION PLANT

almost completely and the pure water is colorless, remains clear on standing, and is odorless. Results of analyses in March, 1915, and August, 1921 (latest available) are shown in the accompanying table. There is no routine laboratory control of the purification process, and the hygienic quality of the water is considered sufficiently constant and secure to require examination of the water from that viewpoint at rare intervals only.

ANALYSES OF BERLIN WELL WATER BEFORE AND AFTER AERATION AND MECHANICAL FILTRATION

	March, 1915		August, 1921	
	Before Filtration	After Filtration	Before Filtration	After Filtration
Temperature, deg. F.	48.2	48.4	49.1	49.6
Ammonia, mg. per l.	0.6	0	0.6	0.02
Nitrites	0	0	0	0
Nitrates	0	0	0	0
Oxygen consumed	16.4	12.0	9.8	5.4
Total solids	360	341	534	528
Total hardness	272	272	335	333
Permanent hardness	36	36	168	168
Sulphates (SO_3)	22.8	20.3	108.5	106.8
Chlorides	16	16	24	24
Iron	4	0	8	0.00–0.03
Manganese	Trace	0	0.3	0.07
Bacteria per c.c.	1	3	0	2

Final Report on Franklin Furnace Typhoid Outbreak

The cross-connection water-borne typhoid outbreak at Franklin Furnace, N. J., late in 1922 (see *Engineering News-Record*, Dec. 7, 14 and 28, pp. 959, 1045 and 1134) caused 114 known cases and 18 deaths, according to the final report on the subject recently completed by Cecil K. Blanchard, assistant epidemiologist, Bureau of Local Health Administration, New Jersey State Department of Health.

An open gate valve and a leaky check valve, both apparently forgotten, between the industrial and the town water supply systems of the New Jersey Zinc Co. were established by tests conducted jointly by the state health authorities and the company as the probable cause of the epidemic. The probable specific infection was two cases of typhoid the dejecta from which would naturally reach the Walkill River a short distance above the intake of the industrial water-supply system.

Inoculation against typhoid was voluntarily taken by nearly half the population of the borough. This and hospitalization, etc., were provided at the expense of the Zinc Co. The local health authorities are credited with efficient work during the outbreak. The State Department of Health undertook, for the first time in connection with an epidemic, to secure two successive negative specimens of stool and urine from all typhoid convalescents before releasing them from jurisdiction—a procedure followed with dairy typhoid cases for some years and held to be "the only method now available to secure gradually a record of the typhoid carrier population." Illness of the local health inspector prevented the completion of this program. Only two known secondary cases among the total of 114 cases occurred.

D. C. Bowen is chief of the New Jersey Bureau of Local Health Administration.

Identification of Douglas Fir

Douglas fir is one of the largest, most abundant and most widely distributed species of trees native to North America, and, next to the southern yellow pines, it is cut in the greatest quantities of all woods of commercial importance. It belongs to the coniferous family and is, therefore, a softwood. Other names for Douglas fir are red fir, yellow fir, Oregon pine, Puget Sound pine, red pine, red spruce, and Douglas spruce. Its botanical name is *Pseudotsuga taxifolia*. As there is a considerable range in the price and suitability of various similar softwoods, the Forest Products Laboratory gives the following identification features: Douglas fir is a resinous wood, with a characteristic sweetish odor. Exudations of resin on end and side surfaces and pitch pockets are common. Occasionally pitch streaks occur. The sapwood, which is from 1 to 3 in. wide, is white. The freshly cut heartwood is light reddish yellow in color. On exposure to light and air it becomes distinctly reddish, sometimes cherry red, or reddish brown, except the outer portion of old trees which often remains light reddish yellow, which explains why the wood is sometimes known as yellow fir. The summerwood is pronounced, except in very narrow rings such as usually occur in the outer portion of old trees. Under the microscope Douglas fir can easily be distinguished from other structural softwoods by the fine spiral thickenings on the inner side of the cell walls, similar to the thread in a nut.

Concrete Bottom for Mechanical Water Filters

Metal Strainer and Air-Wash Replaced by Concrete Channels, Half Cylinders and Spheres Giving High Velocity Wash

BY A. L. GAMMAGE
Engineers' Club, Boston, Mass.

AN ALL-CONCRETE bottom for mechanical water filters has been developed which can be built with a strainer system having any desired ratio of slot discharge to filter area. It can have any proper ratio of length to diameter of laterals. It has side jets which effectively break up and distribute the wash water so there is no danger of lifting movable elements of the filter gravel. Each of a series of upper channels is fed by two separate lower channels. This gives a uniform flow of wash water which the upper channels distribute evenly over the filter floor. There are no pockets below the jets, as in the perforated-pipe system. The all-concrete bottom will effectively break up and evenly distribute the highest velocity jets of water. This type of bottom has been developed in the period from 1919 to 1923 at the plant of the Hollingsworth & Vose Co., at East Walpole, Mass.

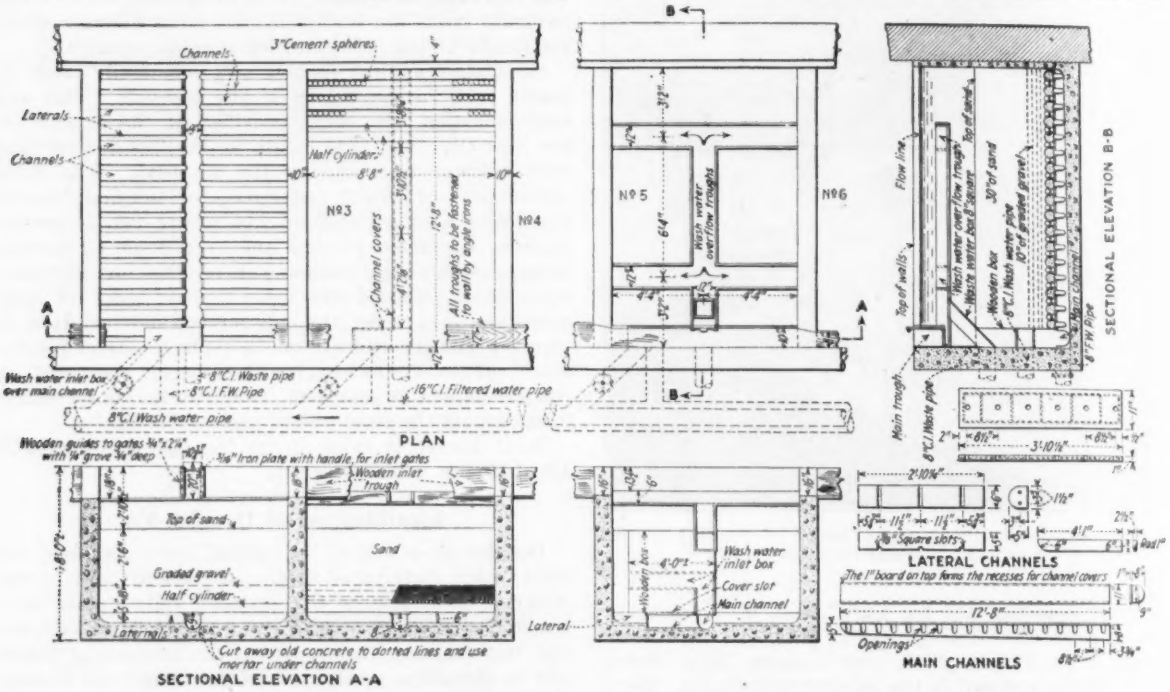
The company just named is the largest manufacturer of rope and jute manila papers in the world. Its East Walpole plant is located on the Neponset River. This stream heads in the Neponset reservoir, Foxboro, Mass. A short distance below its source it is joined by a brook carrying the effluent from the sewage-works of a state hospital. The river is also polluted by trade wastes from rubber factories, cotton washing, bleaching, and dyeing plants, and cotton and paper mills, before it reaches the Hollingsworth & Vose mill pond. The flow of the stream varies from a little more than the 3 to 4 m.g.d. of water used in the mill processes to over 20 m.g.d. at flood time.

The water is highly colored, polluted with suspended organic matter, and low in alkalinity. The color varies from 60 to 200 on the platinum scale; the suspended matter from 10 to 25 p.p.m., with about two-thirds organic, and the alkalinity from 3 to 16 p.p.m. The hydrogen-ion pH is almost always 6.0 or less. The filtered water has a color of 10 to 20 and may be easily made 5 or less.

Nine ¼-m.g.d. air-wash mechanical filters were formerly used to filter the alum-treated water. The strainers and galvanized-iron laterals of these filters corroded so rapidly that they were continually being replaced at considerable expense of money and loss of time in filter operation. The air-wash filters were unequal to the load of work, and about every six months all sand and gravel was removed and replaced by new material.

It was thought that an all-concrete filter would be non-corrosive and if the filter bottom had a large ratio of slot to filter area the velocity of wash water would be great enough to lift the sand and make a high-velocity wash filter. One of the old air-wash filters was changed into a filter built with spheres over lateral channels and a slotted filter bottom with total discharge openings equal to about 4 per cent of the filter-bed area.

This filter worked excellently while it was clean. Until the sand clogged the wash water lifted the whole bed and washed it well. When the sand became dirty the gravel shifted and sand and alum hydrate and suspended dirt passed the filter. The filter bottom was rebuilt several times with decreasing ratio of slot discharge to filter area until a filter bottom was built with raised half cylinders having ½-in. horizontal under-



GAMMAGE ALL-CONCRETE FILTER BOTTOM AT HOLLINGSWORTH & VOSE CO. PAPER MILLS

Bottom wholly of concrete, including channels, raised half-cylinders with horizontal under-slots to form jets and with spheres placed in the spaces between the tops of the half cylinders.

slots 20 in. apart lengthwise, which covered the lateral channels and threw jets opposite each other to a top series of lateral channels covered by 3-in. spheres and gravel and sand. This filter unit had a ratio of slot discharge to filter area of approximately 0.3 to 100. It worked so well that filters 4 and 6 were changed likewise, so that we had filters 1, 4 and 6 on high-velocity working alongside the original 2, 3 and 5 air-wash filters.

The results on comparative tests were such that the company built three new Gammage filters after sketches dated Oct. 20 and Dec. 8, 1919 (not reproduced here). These filters had a ratio of slot discharge to filter area of 0.5 to 100. While this ratio is high, the filters have always filtered and washed evenly, leaving a level sand bed when the sand was dirty. Closing each alternate jet gives a ratio under 0.3 to 100, but this has not been done and no gravel upset has occurred.

To secure a sufficient flow of water from the coagulation basin to the new filters the supply line had to be enlarged to furnish sufficient water for all filters.

After the new filters had been run successfully for some time it was decided to change over three suction filters to high-velocity filters, as all others are gravity filters, and these are giving satisfactory results. They have a ratio of slot discharge to filter area of some 0.4 to 100.

About a year later it was decided to change over the three remaining gravity air-wash filters to high-velocity, and as all the filters were now washing under a 100-ft. head it was decided to tighten the filter bottom to a ratio 0.28 to 100, as shown in the accompanying sketch. On full head the wash water was 28 in. a minute upward in a filter without any sand or gravel in place.

There are three filters each with a ratio of slot area to filter area of 0.28, 0.3, 0.4 to 100 and one of 0.5 to 100 and all are working under a higher wash-water head than is usual in mechanical filters. This wash-water head was used at the East Walpole plant because a tower tank built to supply a certain pressure to the showers of the paper machines on the floor above the filters was the only available wash-water source.

A number of the concrete filters have been surface treated with a zinc magnesium fluosilicate, to form a hard wearing surface.

Acknowledgment is given to John Cashman for all the drafting work and great credit is due the Hollingsworth & Vose Co. for co-operation in the development of a new mechanical filter bottom which is giving them good satisfaction. This mechanical filter bottom has been patented by the writer and has been leased to most of the largest filter companies in the United States.

Crystalline Areas in Wrought-Iron Fractures

Crystalline areas in the nicked-bend fracture of a wrought-iron bar do not necessarily indicate the presence of steel in the material from which the bar was made, nor do they indicate high-phosphorus iron, the Bureau of Standards has found. On the other hand, the presence of steel in the material of the bar does favor the formation of such crystalline areas, because it tends to produce uniform distribution and small size of the individual slag threads, and this latter condition is closely connected with the development of the crystalline areas. In such a test the crystalline areas developed on the tension side of the tested bar are more significant than those on the compression side.

Disinfecting the City Water Mains of Otsego, Michigan

Hypo Applied at Pumps Until Reactions Positive at Flushed Dead Ends—Flushing Kept Up Until Reactions Negative

By Edward D. Rich
Director, Bureau of Engineering, State Department of Health, Lansing, Mich.

TO DISINFECT the seven miles of city water mains after sewage-polluted and muddy water from the Kalamazoo River had been used for years was the problem confronting O. G. Bacon, city manager of Otsego, Mich., three months after a deep-well water supply had been put into use and the river intake disconnected. The work was done by dosing the pump well heavily with hypochlorite and flushing the hydrants until a reaction for excess chlorine was obtained by ortho-tolidin tests. Flushing was kept up after the hypochlorite was discontinued until negative tests were obtained. The work was supervised by the Engineering Bureau of the State Department of Health, with W. C. Brockway in charge.

DEEP-WELL PUMP HOUSE

Located on top of concrete pump well into which deep-well pumps discharge. The two deep wells are drilled through the bottom of the pump well.

Otsego had a population of 3,168 in 1920. While the river had been drawn upon for eight years it was not supposed to be used for drinking purposes. Sewage from Plainwell, population 2,000, four miles above Otsego by river, and from Kalamazoo, population 48,000, fifteen miles above, is discharged into the Kalamazoo River.

The consumption of water is estimated at 400,000 gal. per day. Ten dead ends, mostly on 4-in. mains, exist, ranging from 400 to 1,000 ft. in length. Circulation on many of them does not take place unless hydrants are flushed because there are scarcely any house connections.

It was necessary to clear the mains of mud to get the maximum efficiency from the hypochlorite. For this reason the dead ends were flushed first. Then, starting from the pumping station, hydrants were flushed in order depending upon their distance from the station. After the entire system had been flushed and practically all of the turbidity removed, the dead ends only were opened. The color of the water from some of the dead ends when first flushed was jet black, and as much as one hour was required in some instances before the water became clear in appearance.

After the hypochlorite solution had been applied to the water for 24 hours, dead ends were flushed until a positive reaction for excess chlorine was obtained. Water not chlorinated was not entirely discharged from the system until two days after treatment began. One workman was kept busy continuously at flushing hydrants from Sept. 18 to Sept. 25, 1922, when the hypochlorite dose was discontinued, and until the ortho-tolidin test for excess chlorine gave a negative reaction, which was several days later.

The 130,000-gal. pump well into which the deep-well

pumps discharge water with much agitation at one side of the well, and from which the high-lift pumps have an intake at the other side, offered a possibility for applying the hypochlorite without the offensive task of mixing it into solution manually. With this arrangement the erection of an emergency or temporary plant was not necessary. Accordingly, about 28 lb. of hypochlorite was put into a sack and suspended by means of a rope at the end of the deep-well pump discharge, where the agitation of the water was quite effective in dissolving the chemical. A large initial dose, equivalent to 9 p.p.m. for the 130,000 gal. in the well, was used so that the strength would not be unduly dissipated by this large volume.

Hypochlorite was placed in bags in preference to throwing it directly into the well, because the dose could be controlled better. If the treatment had to be discontinued at any time, the bags could be removed. If the chemical had been thrown into the well, it would have been necessary to wait until the chemical was dissolved. By placing it in bags, no lumps were drawn into the distribution system, thus making the dose more or less irregular and uncertain.

BACTERIAL TESTS ON OTSEGO SAMPLES TAKEN FROM WELLS, DEAD ENDS AND TAPS

RAW WATER FROM WELLS
Sept. 18 to Oct. 3, 1922

	From Discharge Line	Dipped from Pump Well
Safe	12	2
Suspicious	1	2
Unsafe	2	1

	Dead Ends	
	Sept. 20 to Oct. 2 Excess Chlorine Present	Oct. 30 and 31 Chlorine Absent
Safe	17	3
Suspicious	15	1
Unsafe	6	6

	Tap Water	
	Sept. 19 to Oct. 3 Excess Chlorine Present	Oct. 30 and 31 Chlorine Absent
Safe	7	2
Suspicious	4	0
Unsafe	1	0

Treatment applied Sept. 19 to 25 but chlorine persisted until Oct. 2.

An improvised mask, used by the men at the paper mill where the hypochlorite was obtained, was employed by the city workmen, so that no ill effects from handling were evident.

It was found that 21 lb. placed in the well every two hours during the day for seven or eight doses, 15 p.p.m. for an average dose of 400,000 gal. daily, was satisfactory. Since the consumption of water (not for drinking) was low at night, a dose of the disinfectant was placed in the well at 9 p.m. and not replaced until 7 a.m. the next day. Bags previously placed were not removed when a new one was put in. One bag lasted many hours, so several bags were in the well at the same time. The detention period and storage capacity furnished by the pump well were relatively great. These factors and the fact that hypochlorite dissolves slowly, were particularly favorable for this scheme. By means of the ortho-tolidin test it was discovered that the chlorine traveled through the pump well in less than 20 minutes, as shown by the positive reaction in a sample collected from a pet cock on a high-lift pump.

The initial treatment was not deferred until the mains were all flushed, but was commenced at noon, Sept. 19, and continued until Sept. 25, because flushing would draw the treated water to the dead ends that much sooner, even though the presence of organic matter and mud would make the dose less effective. If the treatment had been deferred, a second round of flushing would have been required to replace the raw water with chlorinated water which would have delayed the work about two days.

The only way of testing the efficiency of the treatment was by means of bacteriological specimens sent to the laboratory of the State Department of Health at Lansing. Before, during and after treatment, samples were collected daily from the raw well water and from taps and dead ends on the distribution system. U. S. Treasury Department standards were used for classifying results. To be considered "safe" the "count" was required to be less than 100 with not more than one out of the five 10-c.c. plantings showing gas followed by positive confirmatory results. If the count were greater than 100, and more than one out of five 10-c.c. portions showed gas, the specimen was considered "safe" provided the confirmation was negative, but if the confirmatory test were positive under these conditions, the specimen was classified as "Suspicious" if the standard was but slightly violated, and "unsafe" if decidedly in violation.

Due to delay in shipping (from 24 to 48 hours elapsed before the specimens were planted) it is believed that the counts increased materially and the above classification in consequence is too severe. The result of this classification is that the specimens considered as "suspicious" should in fairness probably be classified as "safe." In most instances, these samples had a count exceeding 100. In some cases specimens classified as "suspicious" were not confirmed but they were so classified because the count of 100 was exceeded. Aftergrowths in the dead ends and during the sample transportation period both tended to give less favorable results than the actual condition would justify.

Pitometer Survey Discloses Underground Leaks

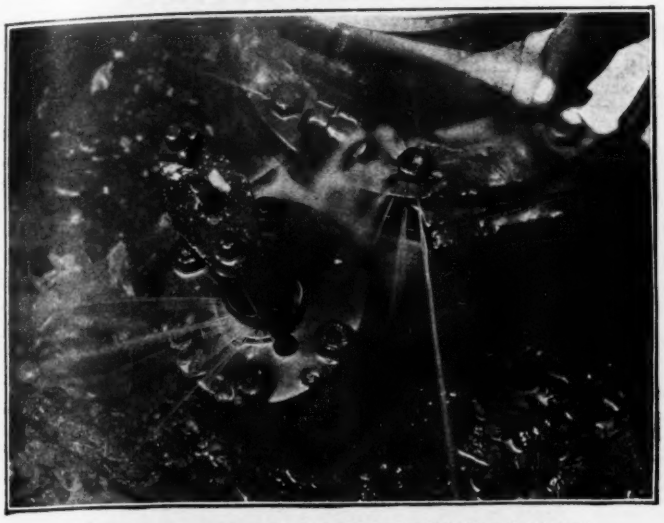
DURING the course of a pitometer survey in Detroit to locate water waste many kinds of leaks were discovered. Photographs were often taken for permanent record of some of the more striking instances to indicate the nature of the defects. Six leaks all in the street are shown on p. 433.

The survey was started July 1, 1919, by the Pitometer Co., which submitted its final report March 1, 1922, since which time a pitometer division of the water department has continued the work. The Pitometer Co. located and the department repaired underground leaks amounting to 9,557,000 gal. daily. There was also 3,380,000 gal. daily of unmetered fixture leakage and 9,600,000 gal. daily of metered fixture leakage eliminated, representing a total of 24 gal. per capita per day saved. The per capita consumption for the year ending June 30, 1922, was 148 gal. Detroit supplies 954,500 people and has 98.5 per cent of the taps metered.

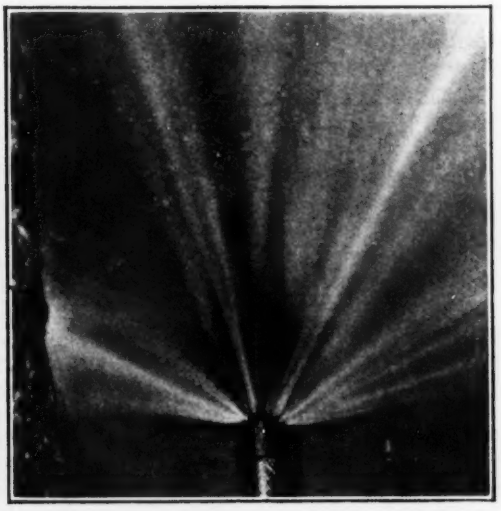
As a result of the survey a systematic removal for test of all house meters is now under way. More than $200,000 is the estimated money saved annually.

The water-waste investigations were carried out under the general direction of George H. Fenkell, superintendent and general manager, Detroit Water Department. The department's pitometer survey is being carried out by Maurice N. Girardy, reporting to F. H. Stevenson, assistant superintendent.

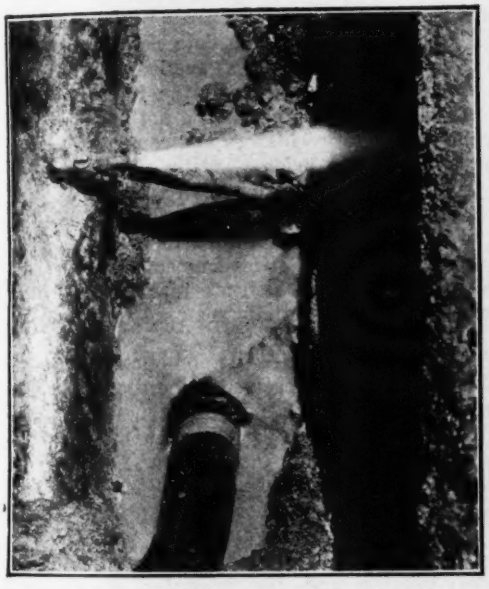
Six of the Leaks Revealed by Pitometer Survey in Detroit's Water Supply



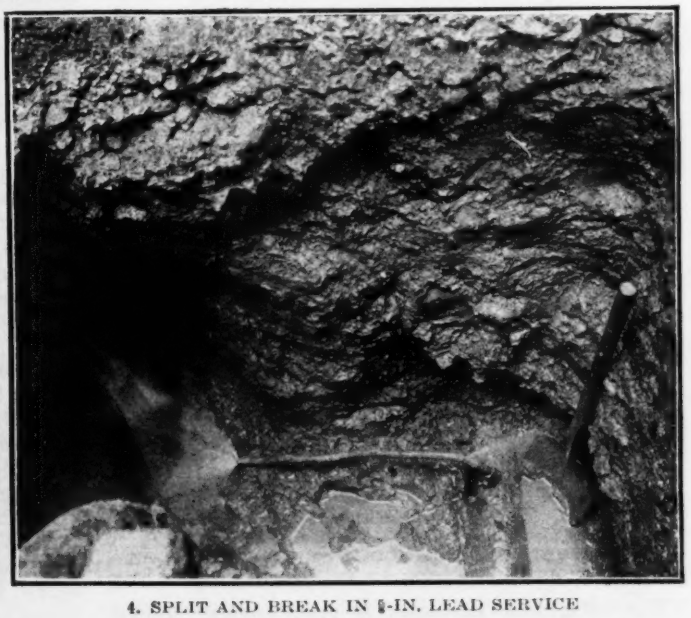
1. DEFECTIVE GASKETS ON STANDPIPE FOOT VALVE



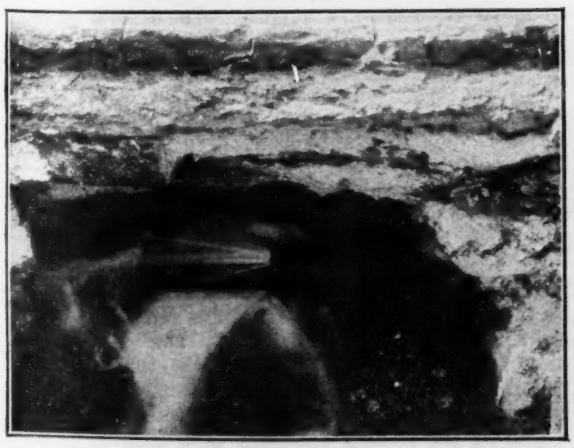
2. BROKEN 6-IN. MAIN; LOSS, 281,000 G. P. D.



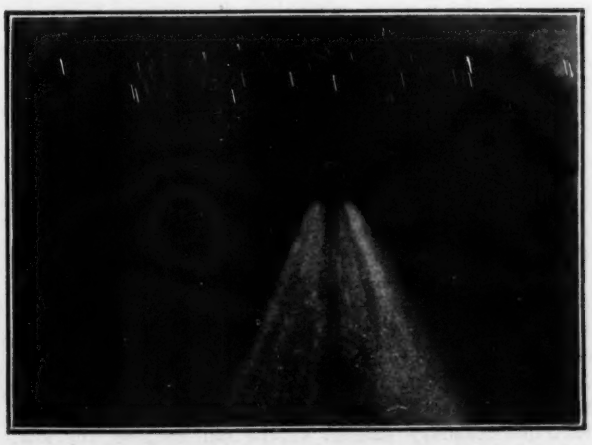
3. A ¾-IN. LEAD BROKEN AT CORPORATION



4. SPLIT AND BREAK IN ¾-IN. LEAD SERVICE



5. VIBRATION BLOWS JOINT ON THIS 4-IN. SLEEVE



6. BLOWN JOINT ON CROSS UNDER CATCHBASIN WALL

Japanese Engineering Structures and Services

Notes on Status of Development in Buildings and Water-Works Before the Earthquake —A Background to Aid Interpretation of News Reports

As a background for later and more detailed reports regarding the effect of the earthquake which shook Japan, Sept. 1, the following notes on structures and services of engineering interest in Tokyo and Yokohama are presented. The comments on building design are based on an interview with Col. W. A. Starrett, of New York, who was connected with the construction of the first large steel office buildings erected in Japan.—EDITOR.

FROM THE fragmentary news that has reached this country regarding the appalling earthquake tragedy in Japan, Sept. 1, it is impossible, as yet, to form any reliable estimate of the effect of the shock on the principal engineering structures in the devastated areas of Tokyo and Yokohama, where, apparently, the most severe damage has occurred. With the loss of life reported as running into the hundreds of thousands the purely technical phases of the great disaster assume a position of secondary importance. Nevertheless, it is certain that in the wake of the world-wide effort that has been started to alleviate the human suffering caused by the great catastrophe, will come many valuable engineering lessons.

MARUNOUCHI BUILDING, MODERN STEEL STRUCTURE
Built by American constructors and reported standing.

The topography of Japan is mountainous. Tokyo, capital of the Empire, comprises uplands and lowlands, with hills ranging from 50 to 130 ft. high. It is located at the head of Tokyo Bay on the southeast coast and along the Sumida River. There are flats on both sides of the river intercepted frequently by canals, over which there are many small bridges. Tokyo is about 18 miles distant, by railway, from Yokohama, the seaport. According to the 1920 census, the population of Tokyo was 2,173,000 and of Yokohama 423,000. For years past records show that Japan is subjected, on the average, to three or four seismic disturbances daily.

Ancient and Modern Structures—While it is true that in design and construction many of Japan's buildings, bridges and other works of the engineer hark back centuries, the application of modern American and European building practice has long since been under way. Within comparatively close range stand the picturesque masonry palaces of the old Empire, the low, flimsy structures of wood or brick in the residence districts, and modern skeleton steel-frame office buildings of the skyscraper type comparable with those that flank lower Broadway in New York. For the engineer, the earthquake, when the full story is known, will undoubtedly contribute valuable information on the comparative stability of the old and the new structures under conditions of extreme shock such as occurred last week. In addition to the modern steel buildings to which reference has just been made, a considerable amount of reinforced-concrete building construction has been in progress in the leading cities of Japan for a dozen years or more. Have these structures stood, and, if so, to what extent have they been damaged? How does their condition, after the earthquake, compare with that of the skeleton steel buildings? Are modern methods of engineering design capable of producing structures which can resist collapse under such conditions as were created by the earthquake in Japan? These are some of the questions to which engineers, the world over, will seek an answer. The data necessary for an analysis of the results are not yet available.

From present reports, however, the indications are that extensive damage has been done not only to buildings, including private residences and commercial structures, but also to the bridges, water-supply and gas systems of Tokyo and Yokohama. In fact, breakage of the water-supply mains is given as one of the chief reasons to account for the failure to check the fires which swept the stricken cities immediately after the earthquake. Later reports indicate that the water supply systems have been partially restored to service.

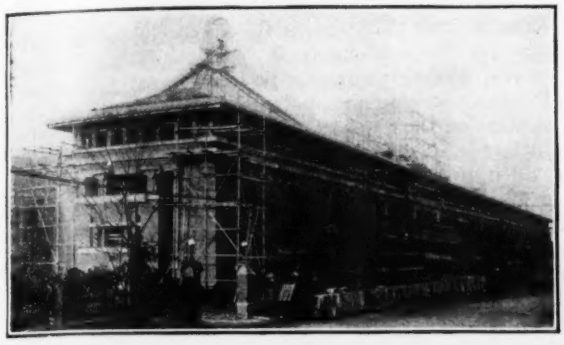
Modern Structures Stand—The one encouraging feature in the news thus far received is the probable safety of certain large steel frame office buildings constructed last year in Tokyo by an American organization, the George A. Fuller Co. of New York. These buildings, described in *Engineering News-Record*, Sept. 21, 1922, p. 476, are all about 100 ft. high (eight stories) and in their design great stress was laid upon providing resistance to earthquake shock in the form of heavy sway-bracing and the provision of adequate foundations by driving timber piles to a firm support 40 to 60 ft. below the surface. The largest of these structures, known as the Marunouchi building, in Tokyo, was eight stories high and covered a plot 340x300 ft. The other two structures were of the same skeleton steel frame type, although somewhat smaller in volume, and were built for the Nippon Yusen Kaisha Steamship Line and for the Japan Oil Co. Through the New York office of The Mitsubishi Co., the big Japanese banking and exporting organization, reports have been received which lead the American constructors to believe that all three structures are standing, although no details are available as to the extent of the damage done to them by the earthquake. These buildings represent the first use, in Japan, of American steel frame office building design and construction. Up to the time they were begun in 1920, modern construction in Japan found its expression chiefly in reinforced concrete.

One of the leading examples of a large reinforced-concrete building in Tokyo is the new Imperial Hotel,

shown in one of the accompanying illustrations. It is faced with brick and is a long, low structure. Reports state that it withstood the shock of the earthquake.

Colonel Starrett Discusses Buildings

In connection with the design and erection of these steel buildings Col. W. A. Starrett, formerly an officer of the George A. Fuller Co. and now member of the firm of Starrett Bros., Inc., New York, has made three trips to Japan since 1919. In an interview last week with *Engineering News-Record's* representative, he



TOKIO'S IMPERIAL HOTEL, OF REINFORCED CONCRETE

brought out the following points regarding Japanese building practice:

For centuries past Japanese construction has employed stone masonry, brick, or wood and only recently has accepted American and European standards involving the use of structural steel and reinforced concrete. Of the latter two types of building, the steel frame structure has made the least headway, and it was only after a delegation of Japanese engineers was sent by their government to the United States in 1919 that negotiations for three large steel office structures in Tokyo were completed.

The reinforced-concrete structure, Colonel Starrett stated, found acceptance in Japan a dozen or more years ago. British and European influence was responsible, in part, for its popularity. For a number of years the trend of design was all toward reinforced concrete, and the building of the large steel structures in Tokyo, beginning in 1920, marked a new era in Japanese building practice. The steel frames of these structures were designed by Purdy & Henderson, engineers, of New York, in collaboration with Japanese engineers. In Colonel Starrett's opinion a factor accounting, in some measure at least, for the widespread use of reinforced concrete by the Japanese is that they came upon the necessity for buildings stronger and better than their old-fashioned methods afforded at a time when concrete construction was prominent in America and Europe. It was a simpler and more practical form for them to adopt and consequently was used in their first fireproof structures. Moreover, the science of steel design was not so well known and the difficulties of detailing and predetermination were very great. The Japanese fondness for decorative ceramic effects on the exteriors of their structures may have had some effect also. In zones subject to seismic disturbances Colonel Starrett points out that such considerations are of secondary importance, for during a severe shock decorative surface applications become detached and fall.

While the Japanese, according to Colonel Starrett's observation, have been profound students of the causes and effects of earthquakes, it has only been during the last half dozen years that they have seen a clear analogy between the wind-bracing methods for steel structures common in American practice and bracing to resist earthquake shocks. Today, however, Japanese designers are attaching great importance to this feature of structural engineering, and the Tokyo office buildings above referred to are notable for their heavy diagonal bracing between columns and girders.

Earthquake shocks also have had an influence on Japanese practice in the design of steel columns. In the cases of columns consisting of successive lengths of steel members superimposed upon each other, the Japanese engineers place no value upon the bearing of the two surfaces against each other, but rely entirely on heavy splice plates, thoroughly riveted, for support at these column joints. This is a detail which was insisted on in the Tokyo office buildings.

OLD BUILDINGS ON YOKOHAMA WATERFRONT

The Oriental scheme of sway bracing, in its general features, is in accord with American practice, except that the wind loads assumed by the Japanese are many times the loadings on which calculations are ordinarily based in this country. Where an American engineer might assume a wind load of 40 lb. per square foot, the Japanese designer would base his calculations on 140 lb. per square foot. This results in exceptionally heavy sway bracing. Experience with earthquake shocks has shown the need for reinforcement of spandrel walls and substantial division walls to form stiff vertical plates throughout the structure.

Foundations—Subsurface conditions in Tokyo and its vicinity make important the subject of foundations for large structures. A large portion of the city is reclaimed ground and for a depth of 50 to 60 ft. below the surface the soil is soggy and swampy. Below the 60-ft. level sand is encountered, and below that, hardpan. Prior to the erection of the large steel office buildings some form of floating foundation was commonly employed in Tokyo, but in the case of the American-built structures the designs called for piers of concrete supported on piles extending down 50 or 60 ft. to a firm bearing. To accomplish this result it was necessary to import long timber piles from Oregon as local timber was too short and too small to penetrate to solid material. Colonel Starrett cited several cases where structures on floating foundations had settled a foot or more. The use of long timber piles in Tokyo, he pointed out, is under ideal conditions, inasmuch as the ground water

level is very close to the surface, so that there is no alternate wetting and drying with its consequent rotting of the timber.

Governmental building regulations in Japan limit the height of structures in the business districts to 100 ft., except where the material used is brick or stone, in which case a 65-ft. limit is imposed. Wooden buildings may not exceed 50 ft. in height.

* * *

Supplementing Colonel Starrett's discussion of Oriental building practice the following comment is based on statements by H. V. Spurr, chief engineer for Purdy & Henderson, consulting engineers, New York, who designed the three steel structures in Tokyo:

Foundations—The chief points in which the Japanese structures differ from American practice are in the foundations and column bases, the column splices, and the heavy diagonal sway bracing. The design followed assures an unusual amount of stiffness in the steel

DETAIL OF HEAVY SWAY-BRACING

frame. The knee-bracing consists of double channels, while there are both web and seat connections between columns and girders. The column splices, to which reference has been made, consist of four 1-in. plates and more than 200 rivets on each side, thus providing material considerably over and above that required for vertical loading. In one case the column splice extends the height of a full story of the building.

A feature of the foundation design is the reinforced-concrete struts which extend between column footings in perpendicular directions like the lines on a checkerboard. These struts tie the whole pile-supported substructure together and are intended to add to the stability of the foundations in the event of earthquake shock. The columns are supported on special built-up bases through which, according to the desires of Japanese designers, anchor bolts extend into the concrete caps of the nests of long wood piles. These bases are equipped with wing angles to provide a connection with the reinforcing rods of the concrete struts and ties between foundation supports.

The spandrel wall details also provide for secure anchorage of terra-cotta or other facing material which might be shaken loose in the event of an earthquake.

* * *

Water Supply in Japan—While the interest of American engineers in the Japanese earthquake will undoubtedly center on the behavior of the buildings in the cities, there are other engineering works whose condition, after the disaster, should furnish data of great technical interest. Tokyo's water supply apparently has been severely damaged. The city, according to observations, made during a trip to Japan a number of years ago by Col. George A. Johnson, consulting engineer, New York, has had a public water supply of some sort ever since the year 1600, but it was not until 1892 that construction started on the present modern water-works system, which was completed in 1898. The original works were designed for 1,500,000 people and had a capacity of 45 m.g.d. Additions have been made to cope with the growing population which amounted, according to the 1920 census, to 2,173,000 people. The intake for Tokyo's supply is from the Tama River at Hamura, whence the water flows by gravity in canals, both open and closed, a distance of 30 miles to a filtration plant on the outskirts of the city. Here are located a battery of sedimentation basins (the original design provided for three, having dimensions of 360x720 ft. and 19.5 ft. deep). The settled water then passed to eighteen one-acre slow sand filters containing 30 in. of sand and 24 in. of gravel. They were designed to operate at a rate of slightly less than 3,000,000 gal. per acre daily, giving a capacity of about 53,000,000 gal. daily. Filtered water passed to three filtered water basins, each with a capacity of 7,500,000 gal.

During the time of Colonel Johnson's visit about two-thirds of Tokyo's supply was delivered by gravity to the low level districts and one-third was pumped to the high level areas against a head of 80 to 100 ft. by four 300-hp. pumping engines, each with a capacity of 7,500,000 gal. daily. Tokyo's water consumption averaged somewhat less than 20 gal. per capita daily.

Yokohama also installed a municipal water-works system in 1885, with an intake on the Doshi River and a 30-mile conduit delivering to a slow sand filtration plant.

Roads and Bridges—Press reports received in this country give scant information as to the condition of bridges and roads in the zone affected by the earthquake of Sept. 1. By the provisions of the Road Law passed in 1919, highways in Japan are classified under five subdivisions: (1) national; (2) prefectural; (3) district; (4) city; (5) village. On this road system, according to the 1921-22 edition of the "Japan Year Book," there are 346,144 bridges, of which 518 are metal, 71,258 stone, and 136,860 wood. In addition, there are some pontoon structures and others of a type not classified.

Japan has about 1,000 harbors, large and small, of which about 60 are open to foreign vessels. Yokohama, where the effects of the earthquake are reported to have been particularly severe, is one of Japan's leading seaports. The engineering works at this port include training walls and piers.

Railway—Prior to 1906 the railways of Japan were operated by a number of companies independently. In that year the railways were nationalized, and seventeen lines, with about 3,000 miles of track, were consolidated into a single system. Extension has been made since that time and in 1920 the mileage of Japan's railways is reported as 6,000. As the capital of the Empire, Tokyo is an important railway terminal. The station is located near the Imperial Palace and is a brick and steel structure about 1,100 ft. long with a maximum width of about 140 ft. The dome of the station is 124 ft. high.

Notes on Roads in the Orient

Observations on a Trip in China, Japan, Ceylon and the Malay States—Modern Machinery Seen But Manual Methods Predominate

By W. W. Crosby
Superintendent, National Park, Grand Canyon, Arizona

ONE LESSON again impressed on the writer by his recent observations of road work in the East is the adequacy of quality to make up for lack of quantity. The road authorities of the East have demonstrated the efficacy of simple methods and moderate expense to meet the needs of their traffic developments. They have not set up the golden calf of quantity production nor have they neglected for a moment the proper devotion to maintenance. And they do not chase any will o' the wisp of "permanent roads."

City Pavements in China—What can be called roads do not exist outside of the immediate vicinity of the cities of China.

A brief inspection in Shanghai revealed streets in good condition though practically wholly of macadam.

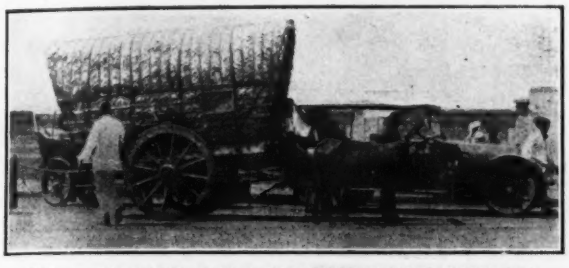


FIG. 1—OX-CART AND AUTOMOBILE BOTH TYPICAL OF CEYLON TRAFFIC

Some have been treated with bituminous material. The maintenance is excellent but the methods are antiquated in instances. One repair gang was seen using as a roller a stone cylinder, pulled by 21 coolies on the draft-ropes.

Canton has few paved roads or streets as we know them. In fact but few roadways for wheeled traffic have been opened up in this curious city. The recent demolishing of the old city walls is leaving some strips of ground for development into streets, but the public highways of Canton are mainly only narrow alleyways between the shops. They are from 4 to perhaps 10 ft. wide, paved with slabs of stone, and usable only by pedestrians and "chairs" carried by coolies.

Rickshas use only the few streets available for them and consequently their employment is over a very limited area. Further, the roughness of the unpaved streets renders riding in wheeled vehicles most uncomfortable and only warranted by their greater speed. The coming of the automobile is tending to bring about some road developments. Even if some roads shall be built, however, the problem of their maintenance is a most serious one. The translation of funds into roadways can be conceived, but no one who knows conditions in China can conceive the raising of funds for road maintenance after construction and then the securing of the work from these funds. Possibly a toll-road company might be operated successfully, assuming a stable government to exist in any section, but the reputations of Chinese officials for "squeeze" prohibit any hopes for good roads in China from public official sources.

FIG. 2—TYPICAL TRAFFIC IN ADEN

Hong Kong's streets and roads are well paved with bituminous surfacing, mostly penetration macadam. In both Shanghai and Hong Kong steam-rollers were seen but even in Hong Kong the stone cylinder pulled by man-power was at work on repairs. While the types and methods of road work in these cities seem rather primitive, the good results everywhere noticed bear witness to the excellence of the work done even in these ways.

The wheeled traffic in China is light, but the use of the motor car is rapidly growing and already a considerable number are evident in Shanghai and Hong Kong, with a few in Canton.

In the Malay Peninsula—The roads of the Federated Malay States are apparently sufficient for their traffic and are well maintained. They are frequently of waterbound macadam and in some cases treated with bituminous material. The macadam is excellently laid and in the moist climate well maintained under what we would call light traffic, mostly rickshas, ox-carts, and passenger automobiles. The heaviest of the last are buses carrying eight or ten persons.

The macadam is of the English type, quite thick, say 8 to 10 in. or even 12 in., frequently with a sort of Telford base, and is well consolidated by steam-rolling. The bituminous treatment is generally carpeting the consolidated and completed macadam with hot bituminous material and grit after the road has been opened to traffic.

A section of old macadam that was really worn out was seen undergoing resurfacing. The new macadam layer was being placed at least 8 in. thick on top of the old roadway and steam-rolled with the aid of water to

FIG. 3—MAINTENANCE GANG REPAIRING WATERBOUND MACADAM IN JAPAN

bind it. Traffic was then turned onto the new surface for a period after which the traffic was again diverted, the surface thoroughly swept and cleaned even by using hand scrapers to remove the last vestiges of adherent matter, and the hot bituminous material was evenly applied and swabbed onto the roadway surface. A coating of sand was then brushed evenly over all and the traffic was readmitted. The results were excellent.

In another place near Singapore some minor repairs were being made to a bituminous roadway as follows: The depressions or chuck-holes in the old macadam were loosened by hand-picking to a depth of about 2 in., with fairly vertical edges, and all the old material was cleaned out. Fresh metal, which had been previously coated with bituminous material, and of which piles existed along the edges of the road ready for use, was then placed carefully in the holes and conformed to the adjacent road-surface by raking and tamping, and this patch was then coated with sand and the traffic permitted on it. Again the results were excellent.

It may be noted that the above described patching is identical with work noted by the writer in Leamington, England, in 1908 and that the same care seems to be taken with small details in Malay road work that is evident in the good work done in England and France. It may be that this carefulness underlies the success of what some might now call antiquated methods in meeting the demands of traffic developments during the past fifteen years.

In the city of Singapore there are many excellent streets. They are wide, well-located, and generally well-surfaced. Bituminous material prevails and it is understood to be largely used in the more superficial methods. Some mixtures have been laid, and the writer had the pleasure of meeting the local representative of our old friend, The Barber Asphalt Co., which is engaged in introducing that standard sheet-asphalt pavement to the Malay States with some success.

One stretch of cement-concrete pavement was seen being laid in Singapore. The construction was truly British—substantial to say the least. It was reinforced near both the top and the bottom, in both directions, and the two layers of reinforcing rods were united by vertical wires or rods. Possibly there were to be also diagonals but they were not in place at the moment. Evidently openings through this pavement were not contemplated soon nor was any surfacing to the concrete apparently provided for.

In the smaller places such as Kuala, Lumpur and Penang, bituminous surfaces in excellent condition prevailed for the streets, and waterbound macadam, equally good, outside except possibly on some of the more popular routes, which were surface-treated with bituminous material.

Ceylon—Traffic around Colombo is extraordinarily varied in character. Rickshas, Rolls-Royce cars, racing-sulkies drawn by one trotting-bullock and a two-wheeled prairie-schooner type of carts drawn by a pair of diminutive oxen, tin-Lizzies and regular steam-lorries from Hold Hengland pulling one or two trailers, a few horses, both saddle and draft, with electric trolley cars on rails are all to be seen on the streets or roads adjacent to this beautiful city.

Again the bituminous-surfaced roadway prevails and is everywhere in good condition. In one wide street a strip of stone blocks along each side next to the curb furnished a roadway for the slow moving animal-drawn traffic. Out in the country some waterbound macadam roadways are in excellent condition.

The maintenance of all the roadways seems promptly and well done. Apparently the use of bituminous surface-treatments is gradually but steadily extending.

The methods used here are those before described for the Malay States but perhaps the tools and machinery or means used in the Ceylon work cover even a wider range. Steam-rollers are numerous. With them work sprinkling wagons or carts consisting of a cylindrical iron tank holding perhaps 150 or 200 gal. of water and drawn by a pair of miniature oxen with their native driver almost always squatting on the pole. Workmen, with their curious long-bladed hoes, scrape the stone free from piles along the roadway into flat scoop-like baskets and carry it to the holes to be patched. One pair of workmen squatted beside a hole some 2 ft. square pack the new metal into it with their hands and sift through their fingers the old material just taken

FIG. 4—JAPANESE MAINTENANCE MAN FILLING A CHUCK HOLE

from the hole, in that way obtaining enough fine material for binding the patch.

The carrying of materials for road work in baskets at each end of a pole across the shoulders of men and women is not quite as common as in Japan but nevertheless prevails even with the bullock-carts seemingly everywhere at work.

The coolie-drawn stone roller was not evident around Colombo but another novelty to American eyes is to be seen in the shape of a stone cylinder drawn by an elephant. Possibly the combination of tamping and rolling effects thus secured is peculiarly beneficial. At any rate the most critical would be pleased with the present roads of "beautiful Ceylon's Isle."

Aden a British Outpost—Here the few roads are British waterbound macadam, well built and well maintained. The steam-roller is again a familiar object but the vehicle traffic is less familiar to American eyes. The most striking vehicles are camel-drawn carts. These seem numerous about the town, in fact they predominate though passenger motors are plentiful.

A curious sight were the road-sprinklers skillfully slopping water from leather bags, slung by a strap over their shoulders, onto the roadway to lay the dust.

Japanese Roads Inadequate—For the traffic of the past, peculiar to its locality, the roads of Japan have undoubtedly sufficed. For their present traffic they are made to answer, extravagantly, probably, in many instances. For the future, the existing roads cannot be considered "good" from the angles of economy, sufficiency or satisfaction to their users.

In the main the roads are too narrow for modern

traffic, too crooked, and too crudely surfaced. In such cities as Kyoto, Osaka, Tokyo, Yokohama, and Kobe many splendidly wide streets exist, but, except in the last two or three places named, scarcely any paving of a modern type is evident. The surfacings, even in the cities, are a sort of macadam made of gravel (or broken stone) without proper rolling and with an excess of fine material to bind the metal. The result is the familiar old one of a soft muddy or dusty road that ruts easily and wears into "chuck-holes" readily.

The maintenance of the more important roads and streets is very good. Apparently labor is plentiful, for a maximum amount of hand work is employed. Gangs are seen constantly at work patching the chuck-holes with broken stone or gravel and spreading fine material over the loose stone so that it may bind down under the traffic.

The writer was fortunate enough to observe such a repair gang at work on The Bund (the waterfront street) of Yokohama one rainy day, and the photographs show the picturesque workmen in their straw rain-coats, some of their implements, and methods.

Some of the men are picking off the bunches in the macadam surface; others are moving stone in a two-wheeled barrow or cart from a large pile alongside the roadway to smaller piles more frequently placed within it (as far as the photos go these latter workmen are "off stage"); others are taking the stone from the small piles to the holes in the roadway in wooden trays. The picture of the single man shows him using the tray and filling a hole. This gang worked industriously and intelligently without argument or unnecessary conversation, which seems worthy of note.

Tokyo has one main street with some good wood-block pavement. Kobe has considerable good bituminous pavement, chiefly of penetration type, as has Osaka.

The street railways, which seem to be astonishingly numerous and popular, in the cities mentioned, are of the "double trolley" type and up-to-date, except that the cars are too small for the crowds they carry. The railway areas are generally well paved with rectangular slabs of stone about 4 in. thick, closely jointed, and from 12x18 in. to 18x30 in. in area. These pavements are generally kept in excellent condition even where the adjoining roadways are of the macadam above described.

In Tokyo some modern road machinery was noticed such as an asphalt roller, a macadam roller, and an elevator with spiral fins or vanes at the base for loading metal from piles on the ground. On the other hand, in Nara a section of road was being repaired and the broken stone was being rolled or consolidated in place by the traffic plus the operations of a stone cylinder about three feet in diameter by four feet long hauled back and forth by five oxen hitched tandem to it.

Wood Preservative in Bored Holes

Marine borers cannot be repelled from piles, poles or other timbers by filling bored holes with a solid preservative. Tests have been made by George M. Hunt, Forest Products Laboratory, as reported in *Wood Preserving News*, on longleaf sap pine specimens 2 ft. long and 6 to 8 in. in diameter bored with 1½-in. holes along the axis. About ½ lb. each of three chemicals, lead nitrate, sodium fluoride and arsenic were tightly corked into the specimens. After 14 months in salt water at Pensacola, Florida, inspection disclosed that the specimens were riddled by shipworms.

Making Meter Maintenance Pay Big Dividends in Texas

INCREASED income from a water-works plant from meter maintenance is seldom looked at from the dividend standpoint and in consequence the figures given below, of the results obtained at Cleburne, Tex., are of particular value. J. W. Hockaday, superintendent, water and sewer department, read the data at a meeting of the Southwest Water Works Association.

Referring to the table, two changes took place in 1917, more meters were installed and more money was spent in maintenance. All of the increase in revenue is credited to meter maintenance because the records show that the efficiency of the plant was not kept up, in fact it fell for several years. Attention is called to the fact that new meters installed do not need maintenance the first years of service. The record for 1919 shows new changes, higher efficiency and increase in revenue with a falling off in pumpage.

TABLE—RESULTS IN REVENUE DIVIDENDS FROM MAINTENANCE OF METERS IN CLEBURNE, TEXAS

Date	Million Gallons Pumped	Meter Maintenance Cost	Number of Meters	Return On Each Dollar Paid Out For Maintenance	Total Revenue	Increase in Revenue
1916	218	$134.52	1,000	none	$43,533	
1917	219	201.30	1,350	$4.00	44,359	$826
1918	226	207.00	1,600	5.00	45,359	1,000
1919	213	749.60	1,775	4.25	48,529	3,170
1920	271	104.14	1,950	loss	44,945	—3,584
1921	291	2,235.38	3,256	7.00	59,044	15,009
1922	219	3,476.26	3,303	6.75*	64,718	5,674

* Of this amount $1.75 was for increased revenue and $5 for decreased operating expense.

As in all cases where changes are made, new complications show up and the operators in 1920 were in a quandary. With an increase in revenue and a decrease in pumpage, the future looked bright, but what disappointment came when at the close of the year the pumpage had taken an airplane trip, while the revenue had gone on a long, long toboggan slide. Rejoicing satisfaction had been turned to disappointment and chagrin. It was determined not to install any more meters. It was figured that while the flat rate prevailed, the revenue was more and the pumpage less than with meters, therefore the conclusion was easily reached and the meters were condemned. This policy is shown by the small amount of money spent to maintain the meters. It was not known that this lack of maintenance was the cause of the whole trouble. Nor was it realized that the meters installed several years previous were slowing up, and that the meters recently installed needed investigation to learn if they too were under-registering. Anyway, the trouble was charged to the meters; practically nothing was done to maintain them and no more meters were installed.

In the first six months of the following year the system was completely metered and a meter maintenance crew was organized; in the last six months of the year $2,235 was expended for meter maintenancce. A marked change took place in the revenue column. Confidently entering the year of 1922, the greatest sum yet was spent for meter maintenance. The end of 1922 showed an increase in revenue of $1.75 for every dollar put into maintaining the meters and a remarkable decrease of $5 in operating expenses.

Possibly this paper should stop right here but the above is not all the story. When efficiency was at the lowest point, it was clearly seen by those who know the situation that the water supply was fast failing. The officials began to cast about for another water supply, and talk of a large bond issue was indulged in. The raising of the efficiency brought this department from a losing to a paying proposition, so that now this same department can swing a bond issue in such a way that it will not cost the people one cent for a new water supply. It is the right thing to install meters, but the battle has just begun then. The meters must be maintained.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Connecting New 60-M.G.D. Pump Sections To An Existing Wet Well

IN CONNECTING two new 60-m.g.d. steam turbine-driven centrifugal units of the Springfield Avenue pumping station, Chicago, to the wet well, a shaft was sunk directly under the pump and a tunnel, 15 ft. long, was driven to the existing pump well. Before work started on the tunnel a sluice gate was set in the old well on a block of concrete over the location of the outlet of the proposed tunnel. With the gate shut the tunnel could then be driven, lined and all connections made without unwatering the wet well which had to be kept in service for the other pumps.

DRILL-HOLE SCHEDULE FOR SUCTION TUNNEL, SPRINGFIELD AVE. PUMPING STATION

Note the close spacing of "primers" and the rows of "helpers." Holes were drilled 24 in. deep but only about 18 in. was peeled off at a time.

On account of the close quarters and the proximity to the pumping machinery above, only small shots in closely spaced holes in the tunnel heading could be used. The 1¼-in. holes were drilled by jackhammers, 2 ft. deep and about 12 in. apart, with four rings in the top half and three rings in the lower half. The photograph of the heading was taken after the last shot had been made and shows the drilling just before starting to use bull points to break through the last foot back of the sluice gate. About the same spacing was used for shooting except for the four holes between the two rows of five "primers" each, outside of which are the rows of "helpers" (four each). Sixty per cent dynamite in 1-in. sticks was used and peeled off about 18 in. at a shot. The bellmouth pump sections were concreted into the shaft over the end of this tunnel making a sealed connection 9 ft. below low water surface.

A sidelight in operation developed shortly after starting these new units in the way of complaints regarding fish in the mains. In winter the screens in the crib in the lake supplying this station are lifted because of difficulty with ice. With the centrifugal pumps the fish came through unharmed and appeared at hydrants and faucets. A rectangular screen cage 6½ x 9½ ft. in plan, 40 ft. high, with the four sides covered with ½-in. mesh No. 12 gage bronze wire screen, was built of angles and plates in the well over the end of the upcoming tunnel. Spring plates 8 x 12 in. long were riveted to the angle at the base of the cage to effect a tight joint. The velocity through the screen at the rated capacity of the station, 120 m.g.d., is 1.2 ft. per second. The wider screens weigh 2,000 lb. All ice is melted by the time it arrives at Springfield Avenue, but the fish do not disappear and it requires one man continually netting them out of the screen chamber. Formerly they undoubtedly went through the pumps and appeared, if at all, as "fish chowder."

The installation of the new pumps is under the supervision of Alex Murdoch, city engineer.

Water Increases Delivery Radius for Gravel Handled in Chutes

IN FINISHING up some of the fills placed in connection with the Ballantyne Pier at Vancouver, B. C., the contractor found it expedient to bring the material in on barges and to unload it by means of a grab bucket also on floating equipment. Part of the area to be filled was out of reach of the boom on which the grab bucket operated and the contractor therefore constructed a hopper or small bunker within convenient reach of the grab bucket boom and at such a height that a chute or flume could be led from the hopper on a 1 to 2 grade to the farthermost point to be filled.

From equipment on hand, a pump was rigged up to deliver water through a 3-in. hose into the lower end of the bunker through a nozzle directed downward into the head of the flume. Material already on the job, chiefly "leftovers," was used for constructing the hopper and the flume, and the lower end of the latter was arranged to be shifted conveniently so as to facilitate even distribution of the fill.

As the fill sloped directly into the tidewaters, there was no drainage problem and the pump was allowed to run continuously. Under this program, as fast as the material was dumped into the hopper it was carried rapidly down the flume to the desired position in the fill; in fact, a much flatter grade could have been used had this been necessary.

The contract is held by the Northern Construction Co. of Vancouver, of which William Smaill is chief engineer.

Carrying Heavy Loads Over An Old Wooden Bridge

By E. C. Seibert
Lieutenant, C. E. C., U. S. Navy, U. S. Veterans' Hospital, Gulfport, Miss.

DURING the progress of 5,000 marines from Quantico, Va., to Gettysburg, Pa., last summer, a bridge over Tom's Creek was encountered near Emmitsburg, Md., which was of interest to the officers for the primary reason that it held up the progress of the 3-mile train (supplies, ordnance, equipment, etc.) because of its inadequate strength. Further, it was of a fast disappearing type, so old as to be curious. It is a statically indeterminate truss-and-arch combination of approximately 66-ft. span, with a shingled gable roof and with covered sides, forming a through bridge. According to a native, its age is 80 years. It is built of white pine, which, above the floor system, is in a very fair state of preservation, considering its age, its chief defect being

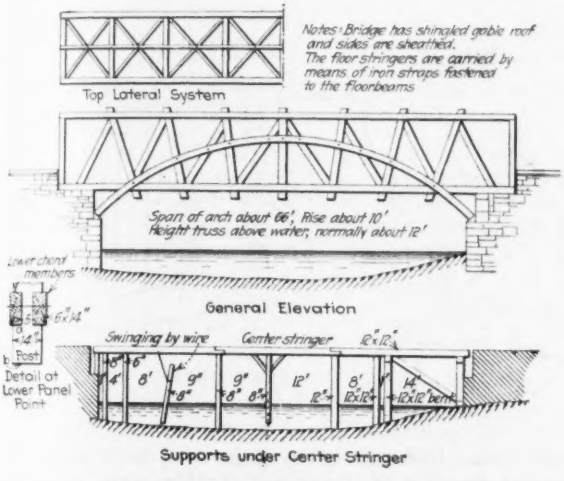

Notes: Bridge has shingled gable roof and sides are sheathed. The floor stringers are carried by means of iron straps fastened to the floorbeams
Top Lateral System
Span of arch about 66'; Rise about 10'
Height truss above water, normally about 12'
Lower chord members
General Elevation
Swinging by wire
Center stringer
Post
Detail at Lower Panel Point
Supports under Center Stringer

FIG. 1—OLD WOODEN BRIDGE AT EMMITSBURG, MD.

the presence of numerous small shrinkage cracks in places. However, the west arch has been broken a few feet from the north abutment, the floor system is badly rotted, and much of the roof and siding has disappeared.

The bridge has been kept standing by the placing of a bent about 14 ft. from the north abutment (near the crack in the arch) and by several posts under the middle stringers, as shown in the drawing. These crude repairs, in effect, converted the bridge into a hybrid of trestle, truss, and arch. According to signs on the bridge, the maximum load allowable is 8,000 lb. This was being exceeded daily. When any load heavier than a touring car passed over, the deflection of the bridge was very noticeable, amounting to several inches in some places. The maximum deflections were reached when the "floating" props under the stringers came up hard against the creek bottom. Upon the advent of the marine train at the bridge, some of the lighter loads were allowed to pass, and part of the train laid by until a portion of the engineer company hastily put in some 8 x 8-in. props, wedged in place. The heaviest loads (tanks, tractors, mounted shops) were detoured several miles over a wrought-iron bridge.

On the return of the marines from Gettysburg, the

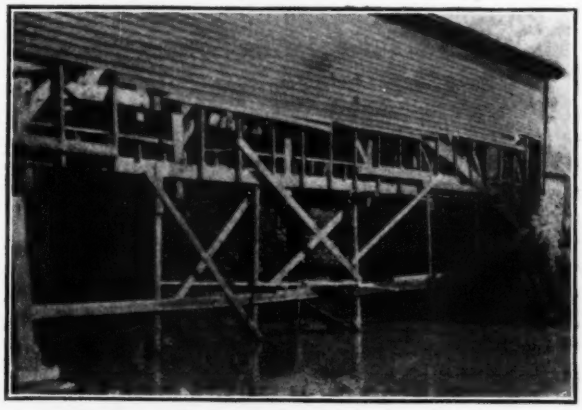


FIG. 2—TRUSSES SUPPORTED ON POSTS TO CARRY ARMY TRAIN

above-mentioned detour having been by rains rendered practically impassable for the heavy equipment, an engineer company was sent in advance of the main body, and in 6 hr. completed the bracing shown in the view, enabling the entire train to pass with safety.

The members of the bridge are connected by wooden pins, except at the points of intersection of the arches with the trusses and at the intersections of the top laterals, where hand-made iron bolts are used. At the panel points the posts run between the two timbers constituting the chord, which are mortised into the post, thereby making the strength of the joint dependent upon the shearing strength of the timber along the planes *a*, *b*.

The portals of the bridge are architectural in character, of simple, classical lines. The bridge is a good example of an honest product, the combination of good craftmanship and wonderfully excellent materials. The writer has never seen recently produced timber which in his opinion would live half as long as has the pine in this old bridge, under similar conditions of service.

Steam Shovel Used to Break Up Tough Wood for Own Fuel

DURING the coal strike early this year which threatened to cut off certain Cuban industries from their supplies, a steam shovel was impressed into service to break up, for its own uses, a species of native buckthorn. No ordinary axe will cut the wood, so G. R. Buchanan, manager of the Cape Cruz Co., of Ensenada de Mora, rigged up the shovel in such fashion that the gang of laborers available was not able to feed the shovel fast enough.

Using an old mill coupling with an 18-in. square opening to take a wedged-shaped broken piece of 17-in. mill shaft, a hammer was rigged to operate in leads made of lengths of old rails. The shovel bucket was used to hold down the ends of the sticks so that they would not fly up when being broken.

With this arrangement 13,054 tons of buckthorn were broken into cordwood lengths at a total cost (which included reloading into cars and unloading into storage piles) of $26,065, or a trifle less than $2 per ton.

The information from which this item was written was supplied by the Marion Steam Shovel Co., Marion, Ohio.

Automatic Sewage-Flow Regulator for Intercepting Sewer

By H. S. Philips
Engineer of Sewer Design, Hamilton, Ont.

A SEWAGE-FLOW regulator to prevent excessive discharge to an intercepting sewer during storm periods has been designed for the Barton St. trunk sewer, Hamilton, Ont. The drawing shows a 54 x 63-in. cunette sewer with a 54 x 51-in. overflow to the Kenilworth Ave. storm sewer and a 24-in. intercepting sewer; also an overhead 15-in. sanitary connection from the Kenilworth South combined sewer, brought to one chamber to avoid duplication of manholes.

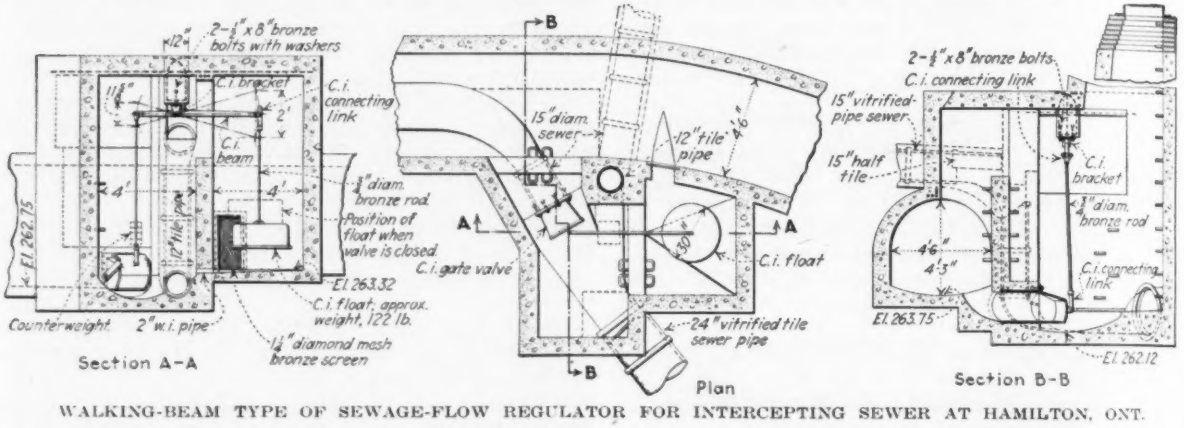
The cunette is designed to carry 1½ times the maximum dry-weather flow when the drainage area is fully developed. This flow will discharge through the normally open regulating gate until the volume increases so that it overflows the berm. As the flow passes the screened orifice, it is diverted to the float chamber, which causes the float to rise and gradually close the gate.

The float chamber has been placed downstream so as to avoid, as much as possible, the offensive deposits which would be formed if the float were placed in the dry-weather flow channel.

The regulator is of the walking-beam type, and consists briefly of a segmental gate valve and a float of the diving-bell type, entirely of cast iron and bronze. The float is 30 in. in diameter and 13 in. high, of ¼-in. metal reinforced by ribs. A lead and a bronze washer are used at the joint between the float and rod, which necessarily has to be airtight. The float is constructed of cast iron in preference to brass or copper on account of the leaks which develop in these sooner or later. The instability produced by the center of gravity of a bell of uniform minimum thickness being above the center of gravity of the liquid displaced is met by partial suspension of the float from a rigid point as high as possible above the bell. The float is counterbalanced by weights on the gate-valve rod, added as required.

The cast-iron gate valve and fittings are of conventional design, having cast-iron faces with ¼-in. clearance, and the gate arms are fitted with bronze bearings. The connecting arms are of ¾-in. bronze rods with a cast-iron link holed for different adjustments on the float side. A simple universal joint of cast iron with bronze tube bushings is placed on the gate connecting rod.

The screen to the float chamber is made up of ¼-in. diameter bronze wire on a 1¼-in. diameter diamond mesh with a ¼-in. diameter bronze frame, and is secured to walls by a ½-in. diameter bronze clamp.



WALKING-BEAM TYPE OF SEWAGE-FLOW REGULATOR FOR INTERCEPTING SEWER AT HAMILTON, ONT.

From Job and Office

Hints that Cut Cost and Time

Large Relief Map Used to Lay Out Logging Railway System

IN PLANNING the woods operations of the Long-Bell Lumber Co. in Washington a topographical map was first made of a 133-sq. mi. tract of land on which the timber stands. Three duplicate relief maps were then made up on a vertical and horizontal scale of 200 ft. to the inch. Different colors were used to indicate different densities of stands, aerial cables were located by threads between pins, and threads on small tacks indicated projected railroads. Telephone lines, roads and other features of the development were also shown. In this way the relief map has proved a great aid in visualizing the scope and plan of the operations. Of the three duplicate maps one is to be kept at the woods headquarters as an aid in visualizing operations, the second will be kept at company headquarters to aid in projecting work in advance, and the third will be sent to the eastern headquarters of the company.

About 250 men were employed in making the field survey. Parallel lines were run through the entire tract, 440 ft. apart in a north and south direction, and, in addition to the section lines, east and west lines were run through to connect quarter-section points. A relief map was made by tracing each 10-ft. contour on cardboard and then cutting the cardboard to the outline of the contour. Each square mile was built up separately, the cardboard sections being glued together on a one-piece wooden base whose lower surface was an assumed datum below the lowest elevation in the tract. When all the sections were assembled the resultant map of somewhat irregular shape occupied an area 25 x 36 ft. The plotting of the notes and the assembling of the sections kept occupied a corps of about 25 men for six or seven months.

From Job and Office

For Contractor and Engineer

Simple Formula Solves Vertical Curves

By Stanley J. Nichols
Civil Engineer, Troy, N. Y.

RECENT park work on which I was engaged involved extensive use of vertical curves. Textbook

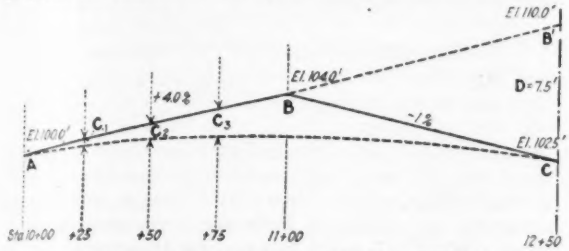


FIGURE FOR SOLVING VERTICAL CURVES

methods of computation proved rather tedious, so the following analytical formula was developed.

$$c = \left(\frac{d}{L}\right)^2 D$$

where c is the offset; D, the distance from the P.C. to the point of offset; L, the length of curve, and d, difference in elevation of the P.T. and the point B'. Then

$$c_1 = \left(\frac{25}{250}\right)^2 7.5 = 0.075$$

$$c_2 = \left(\frac{50}{250}\right)^2 7.5 = 0.300$$

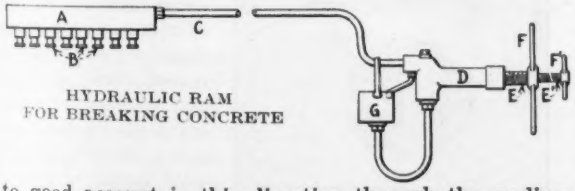
$$c_3 = \left(\frac{75}{250}\right)^2 7.5 = 0.675$$

In this case the offsets are subtractive, the curve elevations therefore being found by subtracting them from the elevations along the tangent line.

Breaking Up Old Concrete by Hydraulic Pressure

By Major Johnstone-Taylor
Lymm, Cheshire, England

REMOVAL of old concrete is often difficult and costly work. Use of hammer and wedge is slow and laborious. The work is often in a confined or populuous area and the use of explosives might be dangerous, or even prohibited. Hydraulic power can often be turned



HYDRAULIC RAM
FOR BREAKING CONCRETE

to good account in this direction through the medium of a simple tool, the hydraulic mining cartridge.

Referring to the sketch herewith: pressure cylinder *A* has fitted to it, rams *B*. It is connected by steel pipe *C* to pump *D*. The plungers of the pump are operated by screws *E* and *E'*, to which are attached handles *F* and *F'*. The tank *G* holds about a quart of water, cylinder *A* and piping being first primed. After this is done pressure is applied by the large handle and screw and final pressure by the small handle and screw.

The average pressure obtainable is 4 tons per square inch, and the machines are made with five, six and eight rams, the largest size, which is 4 in. in diameter and has eight rams, can exert a pressure of 240 tons. This pressure is used to split up the concrete or other mass into large blocks.

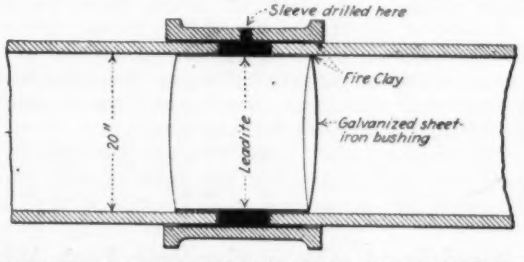
To operate a hole is first drilled. For a 4-in. machine this would be a 4-in. hole, some 36 in. deep. Into this is inserted the tool, the faces of the rams bearing on little plates of $\frac{3}{8}$-in. flat bar. It will be seen that the tool itself is very simple, but it requires machining from very strong material.

The arrangement of the pump shown here is not binding; provided sufficient pressure is available it can be obtained from a high-pressure hydraulic supply if handy, or from an ordinary hand-pressure pump of the type used with tire and axle presses. Generally speaking, however, a pressure of from 3 to 5 tons per square inch is required.

Repairing 20-in. Water Main With Sleeve That Was Too Small

By McKean Maffitt
Superintendent Water-Works and City Engineer,
Wilmington, N. C.

IN SETTING a 20-in. valve in a main we made the mistake of cutting our nipple pieces too short so that when we went to put on the sleeve there was a space of 7 in. between the ends of the pipe. To further com-



BUSHING AND LEADITE USED TO MAKE UP FOR TOO SHORT NIPPLES AND TOO SMALL SLEEVE

plicate matters the only sleeve that we had in stock was so small that it would barely slip over the pipe, not leaving enough space to get a yarning iron in.

The water was off, the pipe was cut, and something had to be done and done at once. This is what we did:

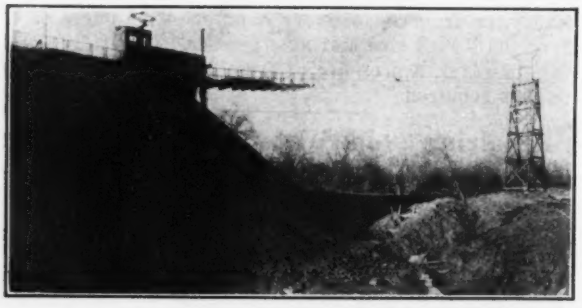
A bushing of heavy galvanized sheet-iron was made with an outside diameter of 20 in. and a length of 12 in. This was slipped inside the 20-in. pipe so as to bridge the space left between the ends of the pipe (see sketch). The space between each pipe end and the outside of the bushing was filled with fire-clay, the sleeve having been forced back for the purpose. The sleeve was then driven back to position and a 1-in. hole was drilled through its middle. The outside spaces at both ends of the sleeve were filled with fire-clay and the remaining space was poured with leadite which made a filler between the ends of the pipe and between the sleeve and pipe and gave us a watertight joint.

The only trouble we experienced was in getting the sheet-iron bushing to fit and in moving the sleeve over the pipe. The sleeve fitted so tightly that we had to use a sledge in driving it along the pipe.

Suspended Track Solves Overburden Disposal Problem

OVERBURDEN covering clay deposits being worked by the Adel Clay Product Co., of Adel, Iowa, is being disposed of easily and inexpensively through the use of the suspended track pictured herewith. To handle the overburden, which ran to an average depth of 14 ft., with men and teams was considered too expensive, so the structure shown here was constructed.

The loaded dump car runs over standard track from the clay pit to the point where the waste material is to be deposited. Here the track is carried out over a ravine by means of two 1½-in steel cables, 640 ft. long, that run to a tower 40 ft. high and are securely guyed. The ties that carry the suspended track are swung 30 in. below the main cables through the use of hangers;



DUMPING EARTH FROM SUSPENDED TRACK

these maintain the center of gravity below the cables. A bumper is provided to stop the car at the right point. The car weighs about 5 tons and handles a load of about 10 tons. One difficulty in tightening the cables was met by providing a four-lug clamp to hold the turnbuckles; a bent tube is used for turning them.

The former cost of about 30 cents per yard for disposing of this overburden has been reduced through the use of this device to a small fraction of that figure.

Repairing Leaks in Concrete Tank When Subjected to External Water Pressure

By R. W. Horne
Fay, Spofford & Thorndike, Consulting Engineers, Boston, Mass.

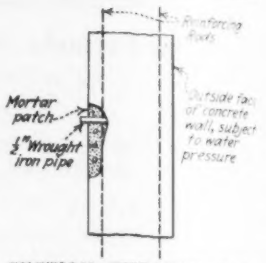
ABOUT three years ago the writer served as resident engineer upon the construction of a concrete fuel oil storage tank of about 2,500,000-gal. capacity. This tank was constructed in made land where it was subject to hydrostatic pressure from tide water, the head of water at high tide amounting to 15 to 20 ft. Inspection of the tank previous to filling it with oil showed a few instances where tide water was leaking into it. As there was to be no special waterproofing treatment of the concrete other than the use of a 1:1½:3 mix throughout, it was very important that all leaks be made absolutely watertight.

In repairing the leaks the method followed was to cut away the concrete to a depth of 2 or 3 in. in the vicinity of the leak until the vein through which the water entered was definitely located. The area over which the concrete had been cut away (sometimes amounting to 3 or 4 sq.ft.) was then repaired with a rich mixture of mortar made with quick-setting cement.

From Job and Office

Hints that Cut Cost and Time

It was soon found that in order to get a tight patch it would be necessary to relieve the water pressure from the fresh mortar until it had "set up"; otherwise the leakage was certain to find an outlet through the patch.



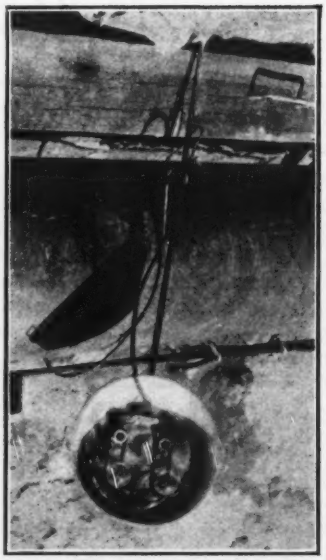
SECTION THROUGH CONCRETE WALL AND MORTAR PATCH

The additional precaution was therefore taken to relieve the water pressure by the use of pieces of ½-in. wrought-iron pipe a few inches long, which were plastered into the patch adjacent to the leakage vein, thus giving leakage water a free outlet through the pipe and obviating all chance of hydrostatic pressure upon the patch. When the patch had become thoroughly set, the opening through the pipe was tightly calked with lead wool, thereby effecting a patch which was certain to give no further trouble.

These patches were made in various parts of the tank which has now been in service for about three years without showing any evidence of further leakage.

Dish-Pan Reflectors Are Effective and Economical

USE OF galvanized-iron dish-pans as reflectors for illuminating night work on the Big Creek project of the Southern California Edison Co. has been most successful. Around the power house site or in the tunnel camps where a permanent location is possible the dish-pans are simply nailed to some convenient post or structure after having been wired for the desired number of sockets.



PORTABLE REFLECTOR FOR LIGHTING NIGHT WORK

The type shown in the illustration is for portable use along the penstock line. In this case the dish-pan is bolted to a 7-ft. length of ¾-in. steel rod, the lower end of which has been sharpened. A reflector of this sort served by a flexible cord can be moved about as desired and thrust into the earth at any convenient point. Two to four 150-watt lamps in this reflector give a broad beam of good light. The cost is very low and when bent or otherwise damaged the dish-pans can usually be bent back into shape and made serviceable again.

From Job and Office

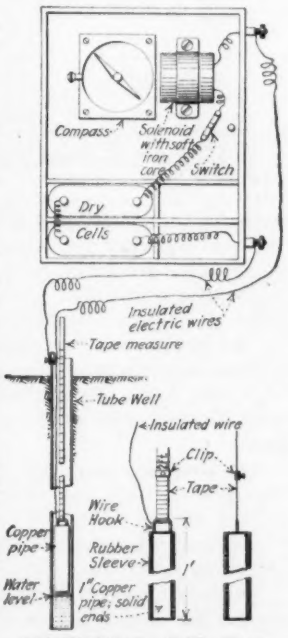
For Contractor and Engineer

Pocket Electrical Device for Measuring Water Depth in Wells

By J. M. C. Corlette
Water Supply & Sewerage Board, Newcastle, New South Wales, Australia

DETERMINATION of water level in wells and pipes has been achieved in various fashions, but the simplest, perhaps, that the writer has seen is described in the following paragraphs. This device was used in accurately determining water levels in 1¼-in. pipes sunk into sand beds from which water was being drawn by pumping.

It consists of a small pocket compass, a couple of dry cells ordinarily used in small cheap pocket electric torches, and a solenoid made by winding fine insulated wire on a cotton reel. One terminal from the cells is connected by insulated wire and a clip to the pipe in which the depth has to be ascertained. The other is connected through the winding of the solenoid to a suitable contact plate which can be lowered down the pipe, being kept insulated from the walls of the pipe. It is suspended by insulated wire and a measuring tape.



ELECTRICAL SET FOR DETERMINING WATER DEPTH

In taking levels the box carrying the compass is placed so that the needle of the compass lies transversely to the axis of the solenoid. On lowering the contact a current flows through the solenoid at the instant the water is reached and the magnetization produced results in a vigorous "kick" of the needle of the compass.

The cells used were about 3 x 2½ x ¾ in., and one was found to be sufficient, though two in series are shown, and they last at least three or four months, with fairly constant use.

The type of contact terminal can, of course, be varied from that shown herewith. One used successfully consisted of a piece of hardwood in the side of which a groove was made to house the insulated wire which continued to its end where it was soldered to a smoothed half-penny piece. It is necessary for the terminal contact to have a fair surface area to get good results.

If the compass is luminous it will be more handy for night work.

The apparatus as used was only roughly made up but gave accurate results over a long period. It would be easy to make it up in compact form to fit the pocket.

Stone-Filled Cage for Protecting Bridge Piers.—A method of protecting bridge piers from underscour which John B. Leonard of San Francisco has used effectively for a number of years is the construction of a stone-filled steel cage around the pier. Railroad rails are driven around the pier about 15 ft. out, and 18 in. apart. Usually these rails are about 20 ft. long. The space inside the rails is filled with niggerheads or any available rock that has rounded corners—sharp rocks have a tendency to wedge and defeat the purpose of the arrangement. When scouring action begins, the smaller rocks, which are always put in first, move toward the affected portion of the cage and effectively prevent the scouring action from getting inside the line of the rails. At the top of the cage, where there may be considerable movement of the filling, the individual stones are too large to pass between the rails. The smaller ones used in the lower portions of the cage are held by the weight above.

Precast "Brick" Lintels—In a building in lower New York City, where building alterations necessitated changes in the positions of windows, lintels, made of precast concrete pieces, were used. The concrete was colored with a pigment to simulate the color of adjoining brick. Joints were cast in the concrete and, after the lintels were placed, pointed with mortar to match the old joints. As the walls where those precast lintels were used were not bearing walls the concrete pieces did not have to have any particular structural strength, though it would have been possible to reinforce them properly if they had been subjected to stress imposed by a bearing wall. Saving in time and labor by using the precast lintels was considerable.

Inexpensive Circular Tank Forms—On a job involving the installation of two 6-ft. water tanks, 30 ft. long, in New York City, the contractor devised a unique method of fitting circular formwork used in placement of concrete forming the supporting walls at either end of the tanks. Plates cut to proper radius were made up of scrap black iron of about No. 18 gage, four or five of these plates forming the required circle. The form boards were cut with square ends nailed to the studs in such a manner that the space between the square end of the form board and the outside of the tank was not over 2 in. The sheet iron pieces were tacked to the inside of the form. The only fixed dimensions on the sheet metal were the 2-in. width at the narrowest portion, and the radius to fit the tank. *Contractor's Atlas* reports a saving of $4 a yard in the placement of concrete with such formwork.

Steel Bars Tie Curb and Gutter to Pavement—In order to secure true line and pleasing finish, and at the same time the structural strength resulting from constructing concrete curb and gutter integral with the pavement, the engineer in charge of paving at Libertyville, Ill., has employed unusual means. The curb and gutter have been constructed first, but with ½-in. round steel bars set in the curb at 3-ft. centers and projecting perpendicularly to the street axis about 9 in. Holes were drilled through steel forms to accommodate the tie bars which effectively tied curb, gutter and pavement together. An additional advantage lay in the fact that curb and gutter could be laid in advance of pavement. A more complete account of this feature of paving construction is contained in a recent issue of *Municipal and County Engineering*.

Abandoned Adit Used As Powder House—An adit that was being driven to tap the tunnel on the Skagit project, now under construction to augment the water supply of Seattle, had to be abandoned, after advancing 160 ft. This was because of the formation encountered, which consisted of large boulders so loosely thrown together that a man could crawl through the air spaces between them ahead of the heading. After discovering that a strong cold draft came out of the abandoned adit all summer long and that it was free from dampness, a powder house was built in the adit entrance and has been found most satisfactory.

Controller Regulates Water Flow Through Pressure Filters

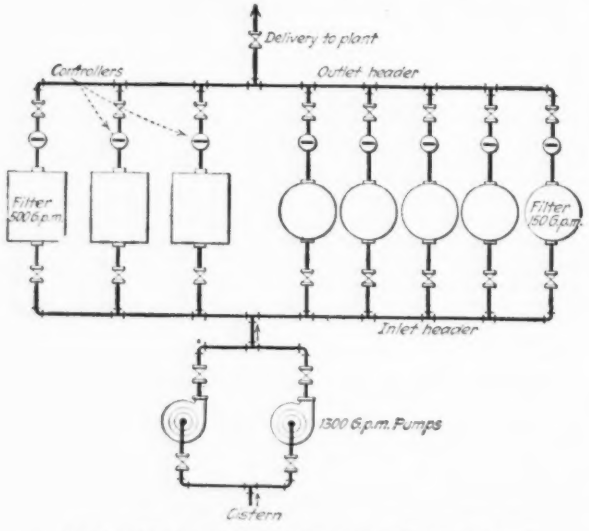
Device Reduces to Safe Capacity Water Passed Through Each of Eight Filters—Process of Filter Washing Also Improved

BY C. C. BROWN
Los Angeles, Calif.

A DEVICE for automatically regulating the flow of water through pressure filters was designed last year for use in a large Western industrial plant and has since been working very satisfactorily, entirely correcting the serious trouble that was the incentive for developing the device.

At the plant referred to there are five small and three large filters connected in multiple between an inlet and an outlet header, as shown in the accompanying plan. The inlet header is supplied with unfiltered water by two 1,300-g.p.m. centrifugal pumps and the outlet header delivers filtered water to the plant through a 12-in. line. The three large filters have an area of 160 sq.ft. of filtering surface and a capacity of 500 g.p.m., while the smaller units have an area of 50 sq.ft. of filtering surface and a capacity of 150 g.p.m.

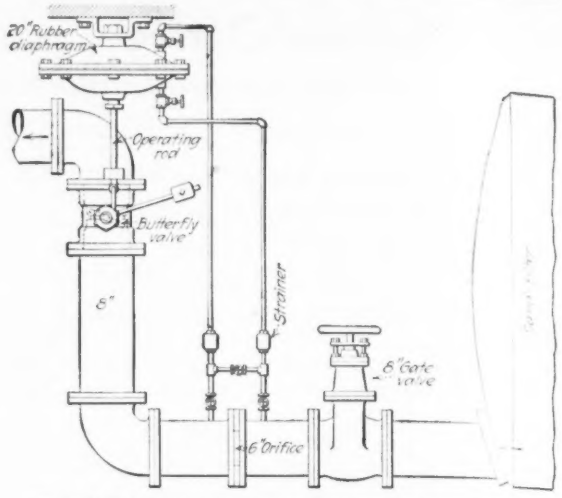
The original installation made no provision for equalizing or pro-rating the flow through the individual filters and as the demand for filtered water was about equal to



ARRANGEMENT OF PUMP AND FILTER UNITS

their combined capacity, a large part of the flow passed through those filters that constituted the most direct route between inlet and outlet. This overburdened the units nearer the center and slighted those at the ends. Water was therefore forced through the centrally located filters at a rate greatly exceeding their normal capacity of 3 gal. per square foot of filtering surface per minute. Tests showed that some of the filters were operating at over 500 per cent rating and not only was the material in the filter beds disarranged, but sand was even driven out into the distribution system.

Another factor which undoubtedly made the trouble worse was the method of washing the filters. Washing was done by cutting a filter out of service, opening the waste valve, and turning filtered water through it in the reverse direction for a period of ten minutes. This wash water was taken from the filtered water line which was under a pressure of 100 lb. per square inch. The valve through which this washing water was admitted to the filters was "cracked open" only far enough to maintain a pressure on the filter side of 15 lb. per square inch. No doubt this method produced a jet action which tended to disarrange the graded material in the filter bed.



ELEVATION OF DEVICE FOR CONTROLLING FLOW

Control is effected by closing or opening of the butterfly valve by movement of rod attached to rubber diaphragm in middle of chamber, two parts of which are connected by pipes to trailing and leading sides, respectively, in the filter effluent.

The problem, therefore, was two-fold: (1) to control the flow through the filters so that each unit would deliver at the maximum rate but could not be forced to a capacity beyond the safe limit, and (2) to provide means of safely and effectively washing the filters.

Automatic control of the flow was accomplished by the regulating device shown in the accompanying sketch. It consists of a counterbalanced butterfly valve operated by a rod attached to a rubber diaphram. The diaphram is in a chamber from the upper side of which a pipe leads to the trailing side of an orifice disc in the filter effluent pipe line. A pipe from the leading side of the disc taps the lower side of the diaphram chamber. As the flow through the orifice increases above a predetermined rate, the diaphram draws up the operating rod and moves the butterfly valve toward the closed position until the flow is cut down to normal. For a decrease in flow the reverse action takes place. This device is said to have successfully maintained the flow in all filters within 2 per cent of the desired quantity.

To provide means of washing the filters without danger of any jet action, a tank was installed at a height above the filter floor sufficient to produce a pressure of 15 lb. per square inch on a dead filter and of sufficient capacity to supply the flow of washing water desired for one filter for 10 minutes with the valve wide open. This storage tank was filled up slowly between washings, thus reducing the large washing demand, and the actual washing operation was not harmful to the filter beds nor did it tax the peak capacity of other filters.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Wants New Word for Concrete Aggregate

Sir—Several years I have urged the use of some other word instead of "aggregate" for the stone element in concrete mixtures. "Aggregate" in the dictionary is defined as "the whole"—not a part. Why not coin a word like "copards," meaning co-partners of cement and sand.

W. D. BROWNING,
Mechanical Engineer.

Memphis, Tenn.,
August 28, 1923.

Simplified Formulas for Eccentric Heel Joint of Truss

Sir—The formulas given by Camillo Weiss in the article "Trapezoidal Portal and Eccentric Heel Joints," in your issue of Aug. 30, p. 339, offer a satisfactory solution of a problem frequently occurring in practice and all too often neglected. For their further simplification, however, I would like to suggest the approximation $l_1/I_1 = l_2/I_2$ instead of $l_1 = l_2$. This makes $M_A = M_B$, thus greatly simplifying the use of the equations in actual design. The results will not be as accurate in some cases, but considering other uncertainties any great accuracy is not warranted, nor is it necessary for design purposes.

Incidentally, I notice that in the article the expressions for M_A ad M_B in the first two cases in which they occur are interchanged, by error.

WALTER H. WEISKOPF.

New York City,
Aug. 31, 1923.

Under Pressure and the Apishapa Earth Dam

Sir—I believe that the following line of reasoning has not been considered by hydraulic engineers and may account for some failures of dams and levees. The failure of the Apishapa earth dam, described in your issue of Aug. 30, p. 357, may or may not have been due to the thing I have in mind, but it is significant that the dam failed when the pool was not full nor even up to the load of the spillway; also that it leaked some time before the failure, and the leaks were stopped and the trouble apparently remedied.

When a leak occurs in the downstream face of an embankment, or on the land side of a levee, the most natural thing to do is to stop that leak by compacting the soil. It is just this process that has given rise to greater leaks and to failures. When the surface soil is compacted, the leaks may be stopped for a while, but a condition is set up by the compacting of the soil in a superficial way that is apt to create a greater menace than the loss of the water that may be trickling through the leak.

I refer to the thing that has caused the failure of so many masonry and concrete dams, namely, under pressure—the accumulation of a water head under a block of masonry or concrete that, with the horizontal pressure on the upstream face, lifts the block and either allows the water to flow under it and wash away the soil beneath or overturns the block, with the result that the dam fails. A large number of dams have failed from this cause, because they were not wide enough at the base to stand against the combined pressure.

The menace in the case of an earth dam is an accumulation of water pressure under a shell of compacted earth that is sufficient to lift it. Once lifted there is exposed a softened mass of soil to which the water has had access, and which that water has rendered semi-liquid. The exposure of this semi-liquid material, and its free vent, results in a leak of greater consequence than the one previously discovered and rolled or tamped to cause it to seal up.

Compacting or paving a surface where water with a head is apt to accumulate under the surface is fraught with great danger. Leaks discovered in such surfaces need special treatment. They should be dug out and the course of the water traced to its source, if possible. Or some sort of sub-soil compacting should be employed, something that will not produce an impenetrable shell for water to lift.

EDWARD GODFREY.

Pittsburgh, Pa., Sept. 1, 1923.

An Irregular Standard

Sir—In *Engineering News-Record*, Sept. 6, p. 372, "An Irregular Standard," 4th line from the bottom of the paragraph, reads: "one may be curious to know." If he wants to know very bad, he might look up "Life of George Stevenson," and find that the old coal pit tramways of about 100 years ago, for which George Stevenson built his first "locomotive engines," had 4 ft. 8½-in. gage; which thus came to be perpetuated; and isn't bad, as you say.

CLEMENS HERSCHEL,
Civil and Hydraulic Engineer.

New York City,
Sept. 7, 1923.

Measurements by Eighths of an Inch

Sir—Recently the plat of a survey in the vicinity of New Orleans was referred to me for interpretation. The sketch showed a front dimension, with notation as follows: 63.11.3′, the lot being subdivided into two plots with dimensions as follows: 31.11.5′ and 31.11.6′, respectively. On first glance it would appear that the last digit represents thousandths of a foot. Another engineer was authority for the interpretation that the notations, in order, represent feet, inches and *tenths* of an inch. A summation of the dimensions however, bears out the writer's conclusion that the dimensions are noted as feet, inches and *eighths* of an inch.

Still more recently, a survey from the same locality, bears the dimension 52′ 6″ 7‴. Is the writer correct in interpreting this dimension, as before? Secondly, are these notations peculiar to certain localities, or are they merely characteristic of the individual engineers preparing the plats?

If there exist systems of notation in various parts of the country differing from the widely accepted standards, a summary of them might be of interest to engineers having to do with data from widely separated localities.

ERIC FLEMING,
Civil Engineer.

New Brunswick, N. J.
Aug. 12.

[The foregoing letter was sent to one of our southern correspondents who gives the following information.—EDITOR.]

Sir—In reply to your letter of August 28 enclosing letter from Eric Fleming, I would say that the dimension 31.11.5′ and 31.11.6′, as well as the dimension 52′6″7‴′ would be interpreted in this vicinity as meaning, respectively, 31′11⅜″, 31′11⅝″, and 52′6⅞″. It is common experience to find dimensions given in this manner in the old notarial records.

It might be interesting to note that in a circular issued some time ago by Grandjean, Daney & Waddill, surveyors of New Orleans, the following explanation of surveying terms used in the South is made:

"The lands of Louisiana while a French colony were first surveyed by *arpents*. Spanish rule maintained this standard of measurement and our laws yet prescribe that plats of surveys shall indicate measurements in French as well as in American measure.

"The *arpent* is the old French lineal measure comprising 30 *toises* of 6 ft. each of the City of Paris. Its true equivalent in American measure varies according to different authorities from 191 ft. 9⅞ in. to 191 ft. 10⅞ in. but is considered as 192 ft., or 2909 chains by the U. S. Government."

This same circular contained a table giving French feet and their U. S. equivalents, the French foot being 1 ft. 0 in. and 6 *lines* (formerly *lignes*) long or 1 ft. and ½ of an inch.

DONALD DERICKSON,
Head of the School of Civil Engineering,
Tulane University.

New Orleans,
Sept. 6, 1923.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Contract for the Installation of 110 miles of automatic train control system between Camden and Atlantic City on the Philadelphia and Reading R.R. has been awarded to the Union Switch & Signal Co., of Swissvale, Pa. The first contract is for $300,000 and the complete work will require $500,000. It is believed that this is only the second case in which a whole division is to be equipped with automatic train control.

The Alaska Mineral Development Co. has applied to the Federal Power Commission for an extension of one year on its preliminary power permit in order to enable it to modify its plans to suit the requirements of the Bureau of Fisheries. The company, which is affiliated with the Guggenheim interests, had submitted plans for a power development on Bradford Canal in Alaska, but the original plan conflicted with the fishing interests.

The Pike Rapids Power Co. has received a license to construct a hydro-electric power plant on the Mississippi River near Royalton, Morrison County, Minn. A dam 42 ft. in height and a power house will be constructed just above the Minneapolis, St. Paul & Sault Ste. Marie R.R. bridge. The project will have an ultimate capacity of 24,000 hp. for use in pulp mills and iron industries.

The War Department Announces that there will be a public hearing held at the County Court House, New Brunswick, N. J., at 2 p.m. daylight saving time, Wednesday, Sept. 26, in the matter of the proposed New York Bay-Delaware River section of the intracoastal waterway. All interested parties are expected to attend and for the purpose of accuracy of records persons having important facts and arguments to present are requested to submit them in writing. Maps showing the location of the proposed canal and the estimates are on file at Room 604 Army Building, New York City.

As a Result of the Dissension between the American and Canadian groups of the Ottoman-American Development Co., arbitrators have decided that Rear Admiral Colby M. Chester and his associates will withdraw from the development company upon payment by the company of $300,000 within 90 days of the award. The Chester group will, however, retain a 10 per cent interest in the Ottoman-American Exploration Co., a subsidiary of the principal corporation. With the withdrawal of the Chester group from the development company, Col. K. E. Clayton-Kennedy, a Canadian engineer, will be the principal representative of the company in the field. Engineers of the company were due to sail for Turkey this week.

Anthracite Miners and Operators Agree on Contract

Agreement on the principles of a contract which is to run two years, and which grants to the miners a 10 per cent wage increase and the eight-hour day, provides for a thorough study of the industry and acknowledges the right of labor to bargain collectively, was made by anthracite operators and miners in a conference in Harrisburg, Sept. 8, as a result of a series of conferences called by Governor Pinchot, of Pennsylvania. The tentative contract was taken before the full scale committee of the United Mine Workers of America, which body ratified it. A tri-district convention is to be called Sept. 17, and upon ratification of the contract by that convention work in the hard coal fields is expected to resume within 48 hours.

Miners agreed at this time to drop insistence upon the check-off on union dues and the operators agreed to give up temporarily at least the demand for arbitration.

Statement of the miners is to the effect that the new contract, which will be in force until Aug. 31, 1925, is the best that the industry has ever seen, so far as they are concerned.

Samuel D. Warriner, spokesman for the operators, asserted after the conference that mine owners were relieved that a settlement had been made, but that he did not believe a wage increase was justified at this time. However, he added that it was not the desire of operators to take the "responsibility of a protracted suspension in the face of Governor Pinchot's proposal."

Philadelphia City Council Stops Arch Street Subway Work

By action of the Philadelphia City Council, funds for construction of the subway in Arch Street have been withdrawn. This action stops work under the contract awarded by the city on July 27 to the Keystone State Construction Co. for $1,198,555. The action of City Council was taken following a message from the mayor pointing out that so long as the money was available he felt compelled to go ahead with the work.

The Arch Street subway was a portion of the "delivery loop" in the business section of the city, included in the transit plans voted upon in 1917. A few months ago the City Council withdrew the funds provided for the subway in Broad Street, and then mapped out new plans for comprehensive transit development in the city. The Arch Street subway is not included in the new plans, and the action of the Mayor under the conditions was very much criticized.

The present action of withdrawing funds after the contract has been awarded may make the city liable for damages for breach of contract, but no such action has been instituted.

Weeks Suggests Eliminating Gorgas Plant in Ford Bid

Detroit Manufacturer Confers With Secretary and Coolidge—Revised Offer Might Be Acceptable

Washington Correspondence

Henry Ford has taken under consideration a suggestion by Secretary of War Weeks that he amend his bid for a long-term lease of the Muscle Shoals hydro-electric project so as to eliminate from this offer acquisition of the Gorgas steam plant on the Warrior River.

Mr. Ford, accompanied by his son and engineers who have handled the negotiations for Muscle Shoals in his behalf, conferred Sept. 6 with Secretary Weeks and also with President Coolidge. Other than that the suggestion would be taken under consideration, there was no formal statement.

The Alabama Power Co., acting under the terms of the contract between it and the federal government when the Gorgas steam plant was extended by the government during the war, has notified the War Department formally that it desires the government to vacate this property and has offered to pay $3,000,000 for that portion of the plant which was built by the government. According to informal statements of high officials of the administration, this price is considered fair.

Amendment Once Rejected

During the months of discussion in Congress regarding the disposition of Muscle Shoals, during which the Ford offer attracted outstanding attention, Mr. Ford declined on several occasions to amend his proposal so as to exclude the Gorgas plant. His desire evidently is to have an auxiliary steam plant where coal may be obtained the cheapest, and Gorgas is located at the mouth of mines on the Warrior River. It has been pointed out, however, that coal could be floated down the Tennessee River to an auxiliary plant at Muscle Shoals itself at low transportation cost.

From the fact that a conference on this subject was held with Mr. Ford at the request of government officials, it is generally believed in Washington that if Mr. Ford were to amend his offer so as to eliminate the Gorgas plant, the administration probably would throw its influence towards acceptance of his bid.

Gage Changing on Provincial Ry.

Changing the gage of the Prince Edward Island Railway from 3½ ft. to the standard gage of 4 ft. 8½ in. is progressing rapidly. It is being accomplished by laying a third rail outside the narrow gage rails to provide for the operation of both standard and narrow gage equipment over sections of track connecting subdivisions having different gages.

Dr. Karl Imhoff Visiting America

Dr. Ing. Karl Imhoff of Essen, Germany, well known for his work in connection with the two-story sewage settling and digestion tank that bears his name, arrived in New York on Sept. 9 for a two weeks' stay. He will visit a few sewage-works in the East and in Chicago and vicinity.

Morris Knowles Heads Pittsburgh Zoning Appeals Board

Morris Knowles, consulting engineer of Pittsburgh, has been made chairman of a three-member commission, to which may be appealed decisions of the superintendent of the Pittsburgh Bureau of Buildings in the matter of zoning law interpretations. The board is empowered to reverse or affirm, wholly or in part, any requirement or determination appealed from, in order to obtain conformity with the zoning ordinance.

The board also is given power to interpret the provisions of the ordinance in cases in which the street layout actually on the ground varies from the street layout shown on the zone maps, in such a way as to carry out the intent and purpose of the zone maps.

Mr. Knowles, who, as chairman of the board, will receive $4,500 a year, is to serve until Jan 1, 1924. The other two members will receive $4,000 a year each.

North End Bridge in Springfield Destroyed by Fire

Special Correspondence

The North End Bridge, connecting the city of Springfield and West Springfield, Mass., and having an estimated replacement value of $500,000, was completely destroyed by fire Sept. 8. It was built in 1878 and was of the Warren type, containing 5 spans, and the first steel highway bridge in the locality. The fire, which it is believed started from a burning cigarette, was given great impetus by the fact that floor joists were tar-coated timbers supporting creosoted wooden block paving. Burning gas from a broken main hastened the bridge's destruction. Within ten minutes three spans had been entirely destroyed and inside of an hour two of the remaining spans had fallen. Firefighters first drew water from a hydrant at a point where the pressure was so great as to burst hose lines. At another point the pressure was too low to be of great service. The falling of high-tension wires also made the firefighting difficult.

The bridge had been repaired and strengthened repeatedly. In 1909 some floorbeams were strengthened and reconstruction work was done on the two end spans. Three years ago a new floor was laid, some steel replaced by stronger members and $25,000 was spent in general repair work by the Springfield Electric Railway Co. The maintenance of the bridge has been mainly borne by the city of Springfield and the town of West Springfield. The opening of the new Hampden County Memorial Bridge last year was designed to relieve the North End bridge of much traffic, but the general opinion prevails that a bridge on the site of the North End bridge is indispensable. An inquiry has been started into probable cost of a new structure. The City Planning Board advises a wider bridge be provided than the old.

Engineer Wins Capital Prize in Traffic Problem Contest

Arthur S. Tuttle, chief engineer of the Board of Estimate of New York City, won the first prize of $1,000 offered by various national vaudeville circuit managers for the best suggestion for relief of New York City traffic congestion. The $1,000 prize, together with one of $300 and another of $200, were offered in connection with the recent Silver Jubilee sponsored by Mayor Hylan.

Mr. Tuttle's proposals include relieving the section adjoining 42nd St. by making all north and south streets one-way streets and introducing the block system of traffic control; continuing Riverside Drive from 72nd St. to the Battery as an express highway or as an elevated structure with occasional ramps to the street; and arcading sidewalks so that the present entire width of congested streets be made available for vehicular traffic.

American Construction Council To Hold Annual Meeting

The annual meeting of the American Construction Council is to be held in the Engineering Societies Building, 29 West 39th St., Friday, Sept. 21. No details of the program are yet available, but it is certain that important matters confronting the construction industry with respect to labor supply and unemployment will be discussed. The Council is co-operating with local building congresses in investigating these problems as well as making a survey of apprenticeship needs.

D. Knickerbacker Boyd, Philadelphia, has been appointed to the recently-created office of executive vice-president, and Dwight L. Hoopingarner, Cleveland, has been made executive secretary.

To Study the Power Resources of Pennsylvania

The State of Pennsylvania has organized a survey board to be known as the Giant Survey Board for the purpose of studying all the available sources of energy within the state and to outline the best methods of utilizing them. The survey will be in charge of Morris L. Cooke, formerly director of public safety in Philadelphia. Other members of the board include Attorney General Woodruff as vice-chairman, Major Robert Y. Stewart as secretary, W. D. B. Ainey, chairman of the Public Service Commission, George H. Ashley, state geologist and Robert H. Fernald, director of the Department of Mechanical Engineering at University of Pennsylvania.

The study will include the possibility of development of power at the mines and the economies to be effected through the recovery of the byproducts from the coal so used. It will also study the question of transmission with special reference to the requirements of small communities and farms, with the idea of putting these people on the same basis as city dwellers as far as power is concerned.

It is hoped that the cost of power will be materially reduced by the proposed large scale production through the reduction of transportation charges on coal and the elimination of waste.

Public Buildings Bill Again Before Administration

Congressional Committeemen Present Coolidge Views on Construction of Federal Buildings

Washington Correspondence

While the situation in the construction industry has eased according to reports to governmental agencies, in so far as over-ordering of materials is concerned, there is no change in sight sufficient to alter the attitude of the national administration toward a widespread program of construction of federal buildings.

Chairman Langley and Representative J. Will Taylor, of the House Public Buildings Committee, recently presented to President Coolidge the views of the majority of that committee that an omnibus public buildings bill with an appropriation of at least $100,000,000 should be enacted early in the life of the next Congress. While admitting the need for more adequate facilities for federal departments in various cities, it is understood that the President indicated opposition to an omnibus bill under conditions which exist at present. This was the view also of the late President Harding, and it is the view of Secretary of Commerce Hoover and of Secretary of the Treasury Mellon.

Proposal Killed Last Season

A proposal for an omnibus buildings bill was killed in the last Congress by opposition from the administration and the same fate appears to be awaiting any similar proposal in the incoming Congress, next Winter at least.

It is understood that President Coolidge agrees with Secretary Mellon who recently asserted that there is imperative need for several buildings in Washington to house branches of the various departments, some of which are now occupying wooden buildings erected as temporary structures during the war and which are rapidly falling to pieces. There is considerable doubt, however, that a building program for the federal government in Washington would be approved by Congress unless it went hand in hand with a considerable program of construction outside of Washington.

It may be possible to secure consent for the passage of a bill authorizing construction in Washington and in a number of other cities, but without carrying an appropriation for the work, actual construction to be held up as a pool for the stimulation of the industry when private contracts become slack. There are a number of conflicting ideas to be reconciled even in a plan of this character, however.

St. Louis Engineers Ask Voice in Expending Huge Sum

The St. Louis section of the American Society of Mechanical Engineers has recommended that an engineer be employed to serve the Citizens Supervisory Committee charged with the administration of the $88,000,000 municipal bond issue recently voted by the City of St. Louis, Mo. The engineers point out that practically all of the work involved by the bond issue is composed of engineering problems, yet not a member of the Citizens Supervisory Committee is an engineer.

Work Forms Commission to Make Reclamation Study

Seven Prominent Men Including One Engineer Invited To Serve on Body

The formation of a fact-fiinding commission to investigate the whole system of Government methods in reclaiming arid and semi-arid lands by irrigation was announced Monday by Secretary of the Interior Work. Invitations were sent to seven citizens of national prominence asking them to serve as members of the commission and conduct an intensive study of the problem. They are: Julius Barnes, president, U. S. Chamber of Commerce; Oscar E. Bradfute, president, American Farm Bureau Federation; James R. Garfield, former Secretary of the Interior; Elwood Mead, consulting engineer and author of works on irrigation and reclamation, Berkeley, Calif.; former Governor Thomas E. Campbell of Arizona; former Governor David W. Davis of Idaho, Commissioner of Reclamation; and Dr. John A. Widtsoe, former president of State University and State Agricultural College of Utah.

TEXT OF INVITATION

The letter of invitation sent Monday by the Secretary of the Interior is as follows:

"The purpose of this letter is to invite you to serve with six other men having national confidence, on a fact-finding commission, to make an intensive study of the policy, application and operation of Government methods of reclaiming arid lands by irrigation, which has become a matter of national concern.

"It is generally reported that relatively few of the original settlers on projects now remain on them as water users. One hundred thirty-four millions of Government money have been expended. Fourteen millions have been returned and six millions are due and unpaid as of Dec. 31, 1922 to which must, very soon, be added computations for the present calendar year.

"Time extensions for payment of both construction and maintenance charges have been asked which, if granted, would multiply deferred annual payments, it is feared, beyond the ultimate ability of the settler to pay, entailing probable loss of his home and to the Government the loss of the investment.

"The purpose of this inquiry, in which I very much hope you may participate, is to have the processes of administration of this trust reviewed by men of affairs applying their best thought to this important governmental agency.

"Reclamation has done much toward the development of the west, but it now clearly requires to be adapted to existing conditions, so that its future success may be achieved and the possibility of home ownership be assured to settlers.

"Your commission will, of course, be provided with suitable offices, necessary data and the courteous assistance of the Bureau of Reclamation.

"As the work progresses, you will be supplied with itemized statements and complaints coming in, of which I must take cognizance, and which may serve to indicate the direction the commission may be prompted to take in its inquiries.

"Although only recently charged with the responsibility of reclamation, I am not a stranger to the irrigation of arid lands, but prefer, however, not to suggest procedure and would not expect to advance opinions to this commission unless requested, asking only that the questions may be treated with open publicity and that I may transmit your report to Congress."

California Allots $10,000 Toward San Pablo Dam Survey Fund

The United States Reclamation Service has made an allotment of $20,000 toward the surveys of the proposed dam across the lower end of San Pablo Bay, which is an arm of San Francisco Bay, and related work, contingent upon an equal amount being provided from other sources. On Aug. 31 W. F. McClure, state engineer of California, announced that $10,000 will be contributed by the state toward this work. It therefore remains for a committee recently created by the Sacramento Valley Development Association to secure the remaining $10,000.

The proposed dam is expected (1) to solve the salt water problem in the lower reaches of the Sacramento River; (2) to afford a large fresh water harbor free from tidal effects; and (3) to provide a highway route across the bay at this point.

Uniformed Crossing Watchmen Command Respect

Due to the flagrant disregard of the warning of crossing watchmen at Youngstown, Ohio, the Erie Railroad Co. has had its crossing watchman appointed as a regular member of the police force of the city and properly uniformed as such. Under this new arrangement he has been able to demand the respect of automobile drivers on the highway the same as any traffic policeman with the result that there have been no more accidents due to disregard of his orders, nor have the crossing gates been broken as they occasionally were previously. The plan has been so successful that other railroad companies are now considering it for use in similar locations.

Detroit Engineering Society Acquires New Home

In early October the Detroit Engineering Society will hold a house warming in a clubhouse which has but recently been acquired. Alterations are now being made on the house, which is a large residence located at 478 Alexanderine Ave., West. Acquisition of the property is the result of a plan definitely outlined a year ago providing for the purchase and equipping of a house for about $65,000, and the incorporation of the society. The society was incorporated in early June of this year.

In order to care for increased service which the society will offer in its permanent and enlarged quarters E. L. Brandt has been engaged as managing director. Mr. Brandt is a civil engineering graduate of the university of Michigan and spent one year with the American Bridge Co., 15 years with the Michigan Central R.R. at Detroit and a year as assistant secretary of the American Association of Engineers at national headquarters.

$175,000 More Asked for Lake Worth Bridge

A bridge across Lake Worth, to connect Palm Beach and West Palm Beach, originally estimated to cost $200,000 will cost $450,000, engineers have reported to the board of county commissioners. The county commissioners have authorized a call for bids for the purchase of $175,000 worth of bonds to provide the remainder of the money needed to complete the bridge.

An eastern engineering firm made soundings of the formation under the lake and estimated the base rock as not thick enough to support the bridge. The rock broke under the weight of piers and sections of the bridge that collapsed eighteen months ago. More complete data as to the foundation caused engineers to agree that many piles would have to be driven; this course was adopted and was one of the reasons why a larger cost will be necessary.

The legislature had authorized the county commissioners to issue the $175,000 additional bonds for which bids will be asked.

C.P. Ry. Completes Two Surveys Across Rocky Mountains

Montreal Correspondence

Four Canadian Pacific Ry. survey parties which have been working in the Rocky Mountains during the past season have, according to press despatches, about completed their work and are now preparing their reports.

It is understood that these parties have been studying two possible routes across the Canadian Rockies with the idea of extending the Edmonton, Dunvegan and British Columbia Ry. from its present terminus at Spirit River in the Peace River country in Alberta to some point on the Pacific Coast.

One of these proposed routes runs due west from Spirit River across British Columbia to a point on the Portland Canal north of Prince Rupert. The second route goes west from Spirit River to Pine Pass in the Rockies and then due south along the Parsnip River to Prince George on the Grand Trunk Pacific and thence south down the Fraser River to connect with the Pacific Great Eastern Ry. at Quesnal, a distance of 380 miles, with a possible 55-mile connection between the southern end of the Pacific Great Eastern and the C.P.R. near Vancouver.

The construction of either line would be a great engineering feat and the proposal is interesting from that point of view but from the point of view of present practicability either seems unnecessary and it is doubtful whether the C.P.R. is seriously considering any such undertaking. There are at present three transcontinental railways across British Columbia which give the greater part of the prairie provinces access to the Pacific ports. The only section that is not so served is the Peace River country, but it is a new country which could not support a railway to the coast. For the present its traffic can be handled eastward through Edmonton. In the future when the traffic offered is greater than the present routes can handle then some such new route to the Pacific will be of real practical interest.

Employment of Engineers Active in Central States

Salaries on West Coast Lower Than Elsewhere—Pay Averages Given for Various Services

Employment conditions affecting engineers are most active in the central and southern states, particularly in the highway, railroad, municipal and building fields, according to the employment service of the American Association of Engineers. In the East and Northeast, conditions are not quite as active but there is a healthy demand for technical services around New York, Boston and Philadelphia, although Boston in comparison is dull. Engineering employment in the western states is sufficiently active to take care of practically all engineers residing in that section of the country.

Engineers in West

The West Coast and Southern California seem to be the mecca for a large number of engineers. High grade men are working for beginners' salaries either because they want to be there or are forced there on account of illness in their families. The A.A.E. Chapter secretaries in California have an oversupply of applications on hand for all classes of positions. However, a fair demand exists for electrical, telephone and architectural engineers but it is rather dull for the structural, concrete, municipal, highway or general construction engineers. Engineers wishing to enjoy the healthful climate of Southern California must, in a measure, be content with a lower salary than secured elsewhere. Practically no assistance can be given eastern men to locate positions in that district unless they go out there to be on the ground when a vacancy occurs.

Average of Salaries

From the best information available from a wide variety of sources covering the entire country, the average engineering salaries per month at the present time are as follows: Tracers, $125 to $150; detailers, structural, mechanical, and electrical, $150 to $215 (a few companies have paid for special short time jobs as high as $250 a month for experienced detailers); designers on all classes of work, $225 to $300, with a few engagements at $325 and $350 where the men were able to take care of squads; estimators, $300 to $350; rodmen and levelmen, $125 to $160 (this includes highways, the municipal field and railroads); instrument men, $150 to $175 (where some responsibility was required such as chief of parties, $175 to $240); assistant engineers, $225 or more depending on responsibility or class of work; map draftsmen, $150 to $200; surveyors, $160 to $190; research engineers, $175 to $250; construction engineers, $200 to $325; superintendents of construction, $275 to $500; resident engineers, $200 to $300 depending on class of work; industrial engineers, $200 to $500.

Salaries for engineers such as building superintendents and mechanical engineers vary with duties and company. For temporary positions, the average is about 20 per cent more than the figures given which are on permanent appointments.

Philadelphia Engineers to Confer on Stream Pollution

A conference will be held at the Engineers' Club of Philadelphia on Oct. 16, afternoon and evening, at which time pollution of streams, especially with reference to pollution by industrial waste, will be the chief topic of discussion. Representatives from the national, state and city governments, and several of the industries most interested in the subject will be present. Papers will be read and discussed by a number of engineers who are recognized authorities and are thoroughly conversant with the subject.

The complete program with the titles of papers and names of speakers will be ready before Oct. 1, and will be sent, together with an invitation to attend the meeting, to any engineers or industrial executives who may desire to be present and take part in the discussion.

Gen. Marshall Elected Head of Quartermasters' Association

Election of R. C. Marshall, Jr., of Washington, as president of the National Quartermaster's Association at the recent meeting in New York is expected to bridge the breach in the membership which was threatening the success of the organization as to whether control should be vested in the regular army officers or in the civilian group.

Gen. Marshall was induced to enter the contest only after being urged to become a compromise candidate. While he is now a civilian, holding the rank of brigadier general in the Reserve Corps and being a member of the contracting firm of Marshall and Maddox Co., Washington, and general manager of the Associated General Contractors of America, for many years Gen. Marshall was an officer in the regular army and served as head of the construction division of the Quartermaster Department during the war.

Gen. Marshall defeated Major Gen. William H. Hart, Quartermaster General of the Army, who was proposed for re-election.

Grand Canyon Survey Reaches Bright Angel Trail

The U. S. Geological Survey party making a trip through the Grand Canyon of the Colorado in boats has arrived safely at Bright Angel trail, Grand Canyon National Park, having traveled 90 miles without serious accident. This party, which consists of ten men headed by Col. C. H. Birdseye, started on Aug. 1 in four specially constructed lifeboats from Lees Ferry, Arizona, to complete a topographic survey of the Grand Canyon as far as Boulder Creek, Arizona, a distance of 310 miles.

The party is provided with a radio receiving set built especially for use in the Grand Canyon, and notwithstanding the predictions of radio experts that it would be impossible to receive radio messages while traveling in the bottom of Grand Canyon, Col. Birdseye reports that he is in daily receipt of messages broadcasted from Los Angeles, Salt Lake, and Chicago.

The party expects to complete its work early in November, but will send out reports of the progress made on reaching Basstrail about Sept. 10, Supai Creek Sept. 20, and Diamond Creek, Oct. 15.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago, Ill.; Annual Conference, Chicago, Sept. 27-28, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 17-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga., Nov. 12-16.

CITY MANAGERS ASSOCIATION, Lawrence, Kansas; Annual Meeting, Washington, D. C., Nov. 13-15.

The Iowa Section, American Water Works Association, will meet Oct. 24, 25 and 26 at Iowa State College, Ames. Preceding the meeting of the waterworks section the fifth conference of sewage operators in Iowa will be held Oct. 22 and 23.

Personal Notes

GEORGE H. FREDERICK, for thirteen years connected with the Department of Public Safety of St. Louis, Mo., and formerly chief inspecto of building, resigned Aug. 31. His successor has not been appointed. Mr. Frederick will be associated with Edward M. David, house movers, St. Louis.

A. M. BARTON, Sacramento, Calif., has been promoted from assistant engineer of the California State Reclamation Board to chief engineer of the board, succeeding Peter R. Gadd.

C. E. FOSS, chief engineer of the New Brunswick Power Commission, and for many years an engineer on the construction of the Canadian National Railways, Transcontinental and Valley branches, has resigned and will live in New Hampshire.

J. G. GWYN, for a number of years chief engineer of the Denver and Rio Grande R.R., has been retired under the pension provisions of the road. He is succeeded by A. O. RIDGWAY, his assistant, and chairman of the safety committee. Mr. Ridgway has been with the Denver and Rio Grande continuously since 1908, serving a year as acting engineer of bridges and buildings, then becoming assistant chief engineer. Previous to 1908 he served other Western roads in an engineering capacity, though shortly after his graduation from the University of Kansas he joined the Denver and Rio Grande engineering forces, acting first as instrument-man, then as assistant division engineer and later as acting division engineer.

C. S. MACALLA, recently vice-president and general manager of the Virginian Power Co., Charleston, W. Va., and vice-president of the Coalburg Col-

liery Co., Ronda, W. Va., has been made vice-president and general manager of the Penn-Ohio Power & Light Co., Youngstown, Ohio. Mr. Macalla is a graduate of Lehigh University and for several years was connected with the General Electric Co. for whom he organized a new factory in Rochester, N. Y., and with the Washington Power Co., Spokane, Wash., where he was for five years vice-president and general manager.

J. C. McLeod, division engineer of the Oregon state highway department, and C. H. Whitmore, market road engineer of Oregon, have resigned to accept positions in the state highway department of California. Mr. McLeod will have his headquarters in Sacramento, and Mr. Whitmore has been assigned to San Francisco.

J. S. SAWYER, resident engineer at Springfield, Ore., for the Oregon State Highway Department, has been appointed a division engineer, succeeding J. C. McLeod, resigned; and J. H. Scott has been appointed engineer in charge of market roads in Oregon, succeeding C. H. Whitmore, resigned.

DORR CO., engineers, New York City, announce the removal of their Scranton, Pa., office to the Miners Bank Bldg., Wilkes-Barre, Pa., the better to serve the anthracite field. JOHN GRIFFEN will still be in charge of this branch of the company.

CAPT. C. W. LOWMAN, of Carman, Man., who since 1919 has been on the engineering staff of the Manitoba government in charge of road improvement work, has gone to Colombia, South America, to take charge of railroad engineering for the Tropical Oil Co.

M. H. FERGUSON, of Toronto, has been appointed resident engineer of Port Hope, Ont.

CHARLES D. VAIL, railway and hydraulic engineer for the Colorado state public utilities commission, Denver, Colo., has been appointed manager of parks and safety for the city of Denver. Mr. Vail is a graduate of the University of Illinois; worked for the Union Pacific Ry. and Oregon Short Line Ry. on surveys, shop construction, division control and railway construction; and later served as assistant engineer of the city water department of Butte, Mont.

Obituary

JULIUS PITZMAN, pioneer of subdivision planning in St. Louis, Mo., died in that city Aug. 31 at the age of 86 years. Having at 16 years of age come to America from Germany, Mr. Pitzman studied civil engineering under his uncle and as early as 1857 he was chief of the county surveyor's office at St. Louis. He served in the Civil War in the Union army, as first lieutenant of engineers and later on General Sherman's staff as captain of engineers, and was wounded at the first siege of Vicksburg. After the war he returned to his post as county surveyor at St. Louis. He laid out Forest Park, Carondelet Park and O'Fallon Park for St. Louis, and also prepared plans for many subdivisions of the city. He was president of the Pitzman Company of Surveyors and Engineers.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

To Curb Profiteering in Lumber for Japan

Manufacturers Oppose Granting of Five-Day Options to Exporters—3,750,000,000 Ft. Needed

Steps are being taken by the Pacific Coast lumbermen, the National Association of Lumber Manufacturers announced today, to prevent the distress of the Japanese people being exploited by speculators. Through R. F. Hammatt, secretary-manager of the California Redwood Association, the directors of the Douglas Fir Exploitation & Export Co., an exporting company of Pacific coast sawmill companies, wired the National Association as follows:

"We believe that inasmuch as a number of exporters are working for five-day options on large amount of lumber for Orient we should not put it in power of speculators to hold up the unfortunate people of Japan but should co-operate with those who are raising funds to relieve their sufferings. We have still approximately 40,000,000 ft. for Japan and it is unanimous opinion of meeting that we should grant no options nor accept any business until we know more about the situation."

In this connection the Red Cross national headquarters at Washington, D. C., authorizes the statement that it is acquiring for immediate shipment 9,000,000 ft. of lumber, half at Portland and half at Seattle, and that 6,000,000 ft. of this amount has been donated by two lumber companies. While there are reports of inquiries from Japan for large quantities for purchase, the Red Cross is not involved.

REQUIREMENTS ESTIMATED

The West Coast Lumbermen's Association, of Seattle, has wired the National Association that it is estimated that the rebuilding of the wrecked portion of Japan will call for the enormous amount of 3,750,000,000 ft. of lumber. This is more than all the mills of Japan could produce in a year and a half, but is not much more than a normal month's output of American sawmills. The 40,000,000 ft. referred to in the above dispatch represents unfilled Japanese lumber orders with the mills of the export company at the time of the disaster, the ordinary lumber exports from the United States to Japan being in large volume.

Outside of British Columbia the United States is the only available source of supply for Japanese lumber requirements. The sudden addition of 3,750,000,000 ft. to the current demand, especially if accompanied by the granting of options to speculators, might result in the absence of precautions that are being taken in the establishment of excessive prices for the lumber needed by Japan at this time. It is believed that the mills will concentrate on filling pending Japanese orders and also those arising from the emergency, deferring as much as possible a portion of the domestic and other export business.

Use of Steel Reinforcement for Concrete Roads Increases

The use of steel in the building of concrete highways in the United States has made rapid strides during the last few years. Expenditures for reinforcing material are now running into several millions of dollars annually, while in addition much of the equipment used in road building is also made of steel, adding considerable to the benefits derived by steel manufacturing companies as a result of the modern methods of highway construction.

Practically every state is now using steel reinforcing materials for the building of roads, with several, including Pennsylvania and California, using it to a greater extent than others. Data compiled by the U. S. Bureau of Public Roads shows that in 1921, the latest year for which official figures are obtainable, for 1,350 federal-aid projects involving 7,480 miles of road at a total cost of $112,325,302, reinforcing steel for bridges and road slabs was used at a cost of $2,375,966. This shows that the cost of the reinforcing material was 2.1 per cent of the total cost of the road.

This amount was divided as follows: Structural steel, $976,571; expanded metal, $50,619, and reinforcing rods, $1,348,806. The figures have not been subdivided to show the percentage of material going into structures and road surface. Also, much steel is being consumed in the erection of metal signs, sometimes mounted on steel pipe or angle rods, which are replacing the wooden sign on the nation's highways.

Motor Vehicle Production

Demand for motor vehicles is holding up well, as indicated by production totaling 348,733 cars and trucks, as reported to the directors meeting of the National Automobile Chamber of Commerce held in New York Sept. 6.

Surveys indicate that fall prospects for both cars and trucks are better than last year. In Georgia, Illinois, Michigan, Nebraska, and parts of the Northwest August business was reported as better than July, though in the majority of the states the demand was reported as slightly less.

The increased production was 6.7 per cent over July and 28 per cent in excess of August, 1922. Last year the August increase over the preceding month was 10.8 per cent. The previous high August record was 272,744 cars and trucks in 1922.

The monthly output of motor vehicles for 1923 as compared with 1922 is as follows:

MOTOR VEHICLE PRODUCTION 1922-23

	1922	1923
January	91,109	243,104
February	122,366	276,467
March	172,720	354,319
April	219,558	382,001
May	256,219	393,193
June	289,011	377,759
July	246,607	327,102
August	272,589	*348,733

* Estimated from carload shipment reports.

Simplified Practice Conferences To Be Held

A final conference of clay products manufacturers, distributors and consumers, looking towards an elimination of excess sizes and varieties, will be held with the Division of Simplified Practices of the Department of Commerce, Oct. 22. On Oct. 19 a final conference of hollow-tile interests will be held, while on Sept. 26, the final conference of the Prepared Roofing Association and allied interests is scheduled. A preliminary conference of garden hose producers and distributors will be held Sept. 14.

Equipment Dealer's Staff Safe in Japan's Earthquake

The Allied Machinery Co. of America, New York City, has received advice by cable from T. G. Nee, president of the Horne Co., Ltd., of Japan, that the entire head office staff of the organization in Tokyo is safe. The exact status of the merchandise stocks and of the records of the business in Tokyo has not yet been determined. Less than one-third of the company's stock is carried in Tokyo. None of the thirteen branches of the company in Japanese territory was affected by the recent disaster. The Horne Co., Ltd., is, therefore prepared to continue its business of nearly twenty-five years standing as distributor in Japan of American manufacturers of machine tools, industrial and construction machinery, building materials and allied lines. The Allied Machinery Co. of America, with which the Horne Co., Ltd., is affiliated, will continue to handle the affairs of the latter in this country.

Construction Equipment Exported

Domestic exports of construction equipment during June have been announced by the Department of Commerce as follows: 23 power shovels valued at $83,490; 12 cranes at $14,198; 394 hoists and derricks (except mining) at $63,450; 61 concrete mixers at $46,728; 504,329 lb. of "other road-making equipment" at $64,245; 1,186,390 lb. of miscellaneous construction equipment at $87,954; 27 conveyors at $13,351; 192 centrifugal pumps at $49,455; 599 steam pumps at $109,711; 2,358 "other power pumps" at $176,179; and 727,019 lb. of "other pumps and pumping machinery" at $246,962.

Three of the power shovels, at $18,553, went to Canada, one at $12,130 to Peru, one at $10,110 to Cuba.

Road Show Exhibitors Meet

A meeting of the Board of Directors of the Highway Industries Exhibitors Association was held Sept. 7 at the office of President S. F. Beatty, Austin Western Road Machinery Co., Chicago. Charles M. Upham, state highway engineer of North Carolina, recently appointed manager of the road convention and show, was present at the directors' meeting to discuss with the representatives of equipment and material manufacturers plans for the exhibit in the Coliseum, Chicago, next January, to be held during the annual meeting of the American Road Builders Association.

To Pave Around British Cenotaph with Rubber Blocks

Noise of London traffic at the cenotaph, Britain's war memorial at Whitehall, has led to special means for insuring silence at the spot to which thousands from all parts of the Empire make a pilgrimage. The surrounding area is to be laid with rubber pavement, the cost of the blocks, estimated at $30,000 being paid for as a gift to the country by Rubber Roadways, Ltd. The superficial area of the strip to be paved with rubber is 1,500 sq.yd., stretching right across the Whitehall carriageway and extending half way to Downing St. on the Westminster side and an equal distance towards Charing Cross. Each block weighs nearly 5 lb. and measures 8x4x3 inches.

Japanese Restoration

Washington Correspondence

While the earthquake disaster in Japan undoubtedly will bring an increase of orders to American firms for building materials, it is not believed by those familiar with Far Eastern affairs that there will be any tremendous flow of such orders. This prediction is based upon the fact that most of the buildings in the devastated area were constructed of wood and in all probability will be replaced by wooden structures. Some slight increase in orders for structural steel may be looked for, it is believed, but not in sufficient volume to affect to any great extent the market for these commodities.

Under the conditions with which Japan will attack reconstruction of the destroyed areas of her Empire, with many of her subjects thrown out of normal employment and hence available for labor, one economist has pointed out that in all probability reconstruction can be accomplished at much less cost than if the same amount of building were to be done piecemeal and under normal conditions.

Contractors Urged to Select Standard Equipment

The Associated General Contractors of America is urging its members to choose their construction equipment in accordance with the recent standards for concrete mixers and wheelbarrows approved by the Joint Committee on Construction Equipment, which has held several meetings recently in Chicago and Detroit.

Manufacturers are given until 1925 to dispose of the non-standard equipment they now have in stock. The bringing of standard equipment into general use, it is pointed out, will have been accomplished long before the end of the coming year. Equipment of the standard type approved will carry name plates showing authorization by the Associated General Contractors and eventually none but mixers and wheelbarrows of the standard type will be available on the market. Name plates to be placed on equipment conforming to the recently announced standards soon will be available to manufacturers.

It is suggested by the contractors' organization that the elimination of unnecessary types or sizes of equipment will reduce the manufacturing overhead and consequently should be reflected in equipment prices.

American Machinery Gains Favor in Japan

Notable Changes in British and American Positions Shown by Commerce Department Figures

AMERICAN machinery manufacturers interested in obtaining a broad view of happenings in their respective lines in Japan will find useful figures compiled recently by the U. S. Department of Commerce, and taken from the Japanese customs statistics. A graphic analysis of these figures by the Industrial Machinery Division of the Department shows the comparatively insignificant part played in this business by the United States in the earlier years; the phenomenal growth of American participation in certain lines with corrresponding waning of the British volume; and the subsequent regaining of lost ground by the British in some cases. In many lines the American manufacturers are holding their own and even increasing their hold, though the British have regained their former prestige, to a large extent in those lines where the original machinery installed was British and the repairs and replacements were of necessity British.

In the earlier years the British controlled the market but in the first part of 1915, owing probably to the war demands on British manufacturers, their participation in this business fell to a negligible quantity, while the American participation took a sharp upward trend. The point of especial interest, the Commerce Department states, is that in the post-war years the British have been unable to regain their former supremacy.

In 1913 the dominant position in the imports of each class of machinery into Japan was as follows:

British	American
Steam engines, boilers, and fuel economizers;	Knitting machinery.
Steam and water turbines;	Gas compressors.
Gas, petroleum and hot air engines;	Blowing machines.
Pumping machinery;	All other machinery.
Cranes;	
Metal or woodworking machinery;	
Paper making machinery;	
Power hammers;	
Spinning, weaving, and tissue finishing machinery;	
Capstans, etc.;	
Hydraulic presses;	
Blocks and chain blocks;	

This comparison shows clearly that the British held the control in the majority of items, their percentage to the total being 48.4, as against the American percentage of 8.7. By 1920 the situation had altered until the British percentage was only 20.6, compared with the increased American percentage of 51.4, and the specific classes of machinery were as follows:

British	American
Steam engines;	Steam turbines and boilers;
Gas, petroleum, and hot air engines;	Water turbines;
Spinning, weaving, and tissue finishing machinery;	Pumping machinery;
Fuel economizers.	Cranes;
	Metal or woodworking machinery;
	Paper making machinery;
	Knitting machinery;
	Capstans, etc.;
	Gas compressors;
	Blowing machines;
	Hydraulic presses;
	Pneumatic tools;
	"All other machinery."

Business Notes

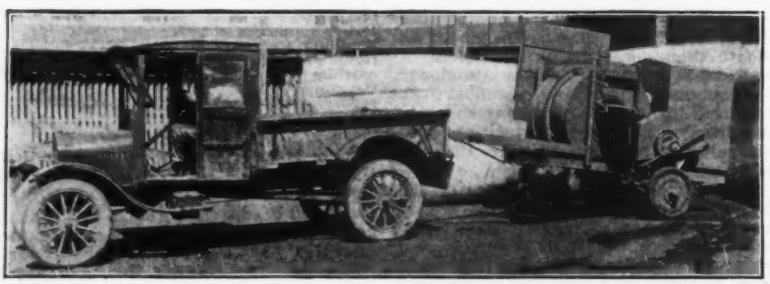
GRAVER CORP., East Chicago, Ind., manufacturers of water softeners, filters, tanks and general steel plate construction, announces the following changes in its district sales offices: The office formerly located at Los Angeles has been discontinued and the Water Works Supply Co., 536 Call Building, San Francisco, will represent the company in the State of California. The Seattle office has been discontinued and the States of Washington and Oregon will be in charge of H. K. Mead, 409 Board of Trade Building, Portland, Ore. The Philadelphia office has been discontinued and L. C. Holmes, 918 Buchanan St., N.W., Washington, D. C., will have charge of sales in that district.

GEORGE A. MCCLELLAN, recently county engineer of Harrison County and stationed at Marshall, Texas, and previous to that state division highway engineer, is now district engineer for the asphalt sales department of the Texas Co. He is located at Dallas. O. F. REYNAUD has been appointed district engineer of the asphalt sales department of the Texas Co. at Houston. Mr. Reynaud is a civil engineering graduate of Texas A & M College.

Equipment and Materials

Trailer Mounting for Mixer

To relieve contractors of the necessity of loading a concrete mixer onto a motor truck when moving from one job to another the Marsh-Capron Co., Chicago, has developed a trailer mounting for its 1-bag Universal mixer which can be towed behind a truck traveling at 25 to 30 miles per hour. The rear axle is equipped with large springs to reduce vibration. As shown in the accompanying illustration the front end



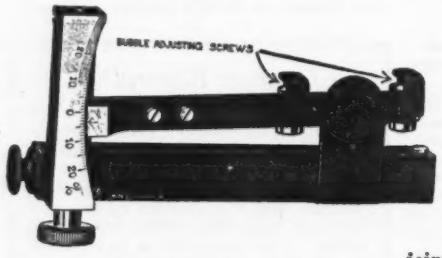
of the trailer is equipped with a double-wheeled swivel castor which is raised clear of the ground during towing and rests on the ground when the mixer is in service so that the outfit may be moved about as readily as with a four-wheel mounting.

The steel disk wheels have 3½ x 24-in. solid rubber tires, and turn on 5-in. Timken bearings on a 1¾-in. heat-treated automobile axle. The springs are of the best automobile truck design, silicon manganese steel, 9 leaves ¼-in. thick by 2-in. wide, 32 in. long overall. The front castor has two roller type wheels, each 3½ in. face by 15 in. diameter; the castor wheels are carried in a heavy cast steel fork, with the pivot pin integral. The triangular tongue is built up of 3½ x 2½ x ⅜-in. angles, with 2½ x ⅜-in. braces. It has a heavy steel clevis riveted to the end, for attaching to trucks, and hand grips besides.

Reflecting Hand Level

A reflecting hand level, intended primarily for use on surveys of roads and railways, but adapted also to the same purposes as any clinometer where the slopes are not greater than 11 deg. 15 min. above or below the horizontal, has been developed by the Keuffel & Esser Co., New York.

Its essential parts are a movable



arm carrying a bubble tube, a graduated limb and a prismoid reflector. It is named the Fallis reflecting hand level.

The bubble tube is large and has adjustment devices similar to those on the bubble tubes of a surveyor's transit. The graduated limb is set perpendicular to the line of sight and is graduated in per cent of grade up to 20 per cent above and below the horizontal. The length of the limb permits direct graduation to single per cents, and the spaces being large, it is possible to estimate to the nearest 0.2 per cent.

The movable arm, which carries the bubble and pointer, is operated by means of a tangent screw, whose head is at the base of the graduated limb. Hence, the bubble may be brought slowly and uniformly to the center of its tube, instead of, as in the Abney level, requiring a direct operation of the hand in positioning and clamping it. The location of the limb and tangent screw at the sighting end of the instrument permits the use of both hands in directing it steadily upon the mark while bringing the bubble to the central position.

All of these features, the manufacturers claim, make possible a considerable degree of precision in measuring slopes and gradients up to 20 ft. rise in 100 ft. of horizontal distance. The instrument is equipped with a narrow prismoid reflector, so located that the field of view appears on both sides of the reflected bubble.

Publications from the Construction Industry

Formwork for Flat Slabs — BLAW-KNOX CO., Pittsburgh, in a 20-p. bulletin, describes and illustrates its metal forms for flat-slab concrete construction, including details of shoring, panels, columns and walls, and outlines the advantages of the use of metal forms. The Blaw-Knox service in the use of these forms includes a rental price on steel forms, erection schedules and a service man to aid in installation and quotations on forms erected in any part of the country.

Asphalt Joint Fillers — MINWAX CO., INC., New York City, has issued a 4-p. illustrated pamphlet on its asphalt joint fillers and calking compounds, including cements for expansion joints of various kinds, calking rope and fillers for grooves and cracks. Points to be followed to secure successful use are also outlined. Drawings illustrate the use of the product in such typical cases as sidewalk expansion joints, bridge expansion joints, block paving joints, spandrel wall expansion joints, and flushing grooves at curbs.

Rail Welding—METAL & THERMIT CORP., New York, has issued a 72-p. illustrated booklet bringing up to date the subject of thermit rail welding. Detail instructions are given for making improved rail welds. For this purpose apparatus has been developed including the self-luting mold box and a new lightweight double burner preheater. Results of rail bending and drop tests are given. The pamphlet concludes with a discussion of the theory of rail joints.

Rock Crushers—UNITED IRON WORKS, INC., Kansas City, Mo., features its portable and stationary rock crushers in a recently published bulletin. The capacities range from 6 to 35 tons of material per hour. The crushers are of the jaw type, requiring for operation from 6 to 20 hp. Several illustrations show the crusher at work on road construction, together with auxiliary plant in the form of bucket elevators, screens and bins.

Pine Floors—SOUTHERN PINE ASSOCIATION, New Orleans, is distributing a 16-p. illustrated booklet containing detailed directions for the laying, finishing and care of Southern pine floors in commercial buildings, private homes, theaters, banks, schools, armories, and factories. The booklet is entitled "Beauty Plus Service in Floors."

Steel Wheels—GENEVA METAL WHEEL CO., Geneva, Ohio, features its steel wheels for all kinds of portable outfits, except automobiles, in a newly issued 29-p. illustrated booklet. The wheels are of both light and heavy design for construction equipment such as wheelbarrows, concrete mixers, crushers, tractors and trailers, portable pumping plants, wagon loaders, etc. The wheels are constructed in a variety of diameters and tire widths.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Production and Materials Stocks in Nine Cities

Iron Output Lower—Production of Other Materials Increased—Unfilled Steel Bookings Dropped 496,100 Tons

Iron and Steel—August pig-iron output totaled 3,435,000 tons as against 3,678,000, for the month preceding, a decrease of over 6 per cent.

Steel ingot production, however, reached 3,508,347 tons during August, compared with 3,350,829 for the preceding month, a gain of nearly 5 per cent. Compared with one year ago, the August steel output gained over 54 per cent according to the American Iron and Steel Institute.

Unfilled steel tonnage, on books of the U. S. Steel Corp., Aug. 31, totaled 5,414,663 tons, compared with 5,910,763, July 31 and 7,403,332 on Mar. 31, 1923.

Lumber—Production is proceeding at about 10 per cent above normal as against 7½ per cent, one month ago. Shipments are a trifle under, and orders slightly over, 100 per cent of normal production, according to the National Lumber Manufacturers' Association. Production, shipments and demand, all increased materially during August. One year ago, however, production just touched normal, with shipments nearly 90 per cent and orders, 92½ per cent of normal production. The following table shows lumber movements during the four weeks ending Aug. 25, compared with the preceding four weeks:

	Four Weeks Ending Aug. 25 Ft. b.m.	Four Weeks Ending July 28 Ft. b.m.
Cut	1,095,378,957	1,010,866,675
Shipments	936,731,282	887,243,878
Orders	879,684,526	808,465,374

Cement—Reserve stocks, throughout the entire country Aug. 1, totaled 8,076,000 bbl. as against 8,433,000, for the corresponding period in 1922, according to the Geological Survey. Production, however, totaled 74,940,000 bbl. for the first seven months of the current year as against 58,475,000, for the same period last year. Shipments reached 75,938,000 bbl. for the first seven months of 1923, compared with 61,879,000, for the same months in 1922. Compared with this time last year, the cement situation is one of increased production and shipments with a slightly smaller reserve stock on hand.

Brick—Report of the Common Brick Manufacturers' Association of America, as of Aug. 1, shows 179,574,000 burned brick on hand, at yards throughout the country, compared with 153,487,000 on July 1. Orders on books decreased 13 per cent in month. The drop in unfilled orders is purely seasonal, and leaves a better reserve of both burned and unburned brick than was available a month ago, but represents a decrease of 2 per cent under the amount on hand Aug. 1, 1922.

Los Angeles—Sewer pipe stocks normal. No shortage of lime or cement; mills active and constantly increasing capacity. Steady demand for brick, tile and structural steel being met promptly. Enough native asphalt for requirements. Large lumber supplies at harbor.

Denver—No surplus of hollow tile and sewer pipe at present. About 5,000,000 brick in dealers' yards. Lumber stocks trifle below normal.

Minneapolis—Lumber reserves in Twin City field reported close to normal; probably 50,000,000 to 60,000,000 ft. in yards, which is slightly below par for season. Stocks of lime, cement, brick and tile continue ample.

Detroit—Plenty of sewer pipe in sizes up to 36 in.. Cement scarcity reported on nearby road contracts; no actual shortage in city. Ample warehouse stocks of lime. Large brick reserves in local yards. Tile deliveries require several days where large quantities are involved. Lumber yard stocks normal.

Chicago—Sewer pipe stocks low; deliveries take 24 hr. Hollow tile reserves below normal; deliveries require one week to ten days. Sand and gravel shipments in two to three days. Other materials in good demand and plentiful.

Cincinnati—Plenty of sewer pipe, asphalt, lime, brick and hollow tile. Cement scarce. Fair supply of lumber in dealers' yards.

New Orleans—Stocks of Southern pine still below normal; other building materials ample.

Atlanta—About fifty cars each of lime and cement; seventy-five, of asphalt and from four to six cars of structural steel on sidings. Sewer pipe and hollow tile deliveries take from four to five days. Plenty of brick and lumber.

New York—Considerable quantities of brick from Germany and Holland reported to be coming into this market. Thus far, the importations have had no effect upon the price of the domestic product. Except for slight shortages in sewer pipe and steel plates, the building materials market in this city faces no danger of scarcity.

Freight Car Loadings Smash All Previous Records

All previous records were eclipsed in the loading of revenue freight during the week of Aug. 25, according to figures made public last week by the Car Service Division of the American Railway Association. The total for the week was 1,069,932 cars. This exceeded by 28,888 cars the previous record which was established during the week ended July 28 this year, when 1,041,044 cars were loaded. This also exceeded by 51,393 cars the record of 1,018,539 cars established in the fall of 1920, and which stood until this year. The total for the week of Aug. 25 made the tenth week this year that the million-car mark has been exceeded, and in six of the ten weeks the total exceeded the record established in 1920.

Despite the fact that loading of revenue freight for the week of Aug. 25 was the greatest in the history of the nation, the railroads on Aug. 23, the latest figures available, had nearly 75,000 surplus freight cars in good repair and immediately available for service, while on the same date the car shortage reported amounted only to 7,690 cars.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Common brick, Denver, 5,000,000); time required for delivery of carload lots to city job, example: (Sewer-pipe, Atlanta, 4 to 5 days); and stocks on hand in general terms, example: (Cement, Cincinnati, scarcity)

	Los Angeles	Denver	Minneapolis	Detroit	Chicago	Cincinnati	New Orleans	Atlanta	New York
Sewer pipe	Stocks normal	No surplus	Ample	Plenty, sizes up to 36 in.	Stocks low; del. 24 hr.	Plenty	Abundance	Del. take 4 to 5 days	Shortage
Cement	No shortage; mills active	Enough	Sufficient	Stocks decreasing	Stocks in good shape	Scarcity	Dealers' stocks large	About 50 cars	Mills supplying city steadily adding to daily capacity
Lime	No shortage	Plenty	Enough	Warehouse stocks ample	Plenty	Ample	Plenty	About 50 cars	Market well supplied
Common brick	Demand met promptly	5,000,000	No shortage	Local yards well stocked	Heavy reserve of burned brick	No scarcity	Enough to fill requirements	Plenty	Considerable quantities of German and Dutch brick in market
Hollow tile	Meeting demand	No surplus	Requirements met	Dealers' stocks moderate	Below normal; del. 1 wk. to 10 days	Enough	Ample	Del. take 4 to 5 days	Shipments meeting demand
Lumber	Large supplies at harbor	Trifle below normal	60,000,000 ft. in yards	Yard stocks normal	Dealers' stocks in good shape	Fair supply in yards	Improved during month	Plenty pine	Time of delivery good
Asphalt	Enough for requirements	Sufficient	Plenty	Enough in stock	.....	Plenty	No market	About 75 cars	Heavy reserves in N. J.
Structural steel	Little delay in deliveries	.....	.....	No shortage	Mill shipments exceed bookings	Fair stocks of fabricating materials	.....	About 4 to 6 cars	Low stocks of plates in warehouses

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 143 to 158, are the following:

Hotel, New York, N. Y., G. F. Pelham, archt. and engr., $2,000,000.

Hotel, Ashland, Ky., for Buckingham Hotel Co., $1,325,000.

Home and infirmary, Louisville, Ky., for St. Joseph's Infirmary, $1,000,000.

Apartment, Philadelphia, Pa., for 13th and Locust St. Realty Co., $1,000,000.

Hotel, Duluth, Minn., for C. Schroeder & Sons, Milwaukee, Wis., $1,000,000.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 143 to 158, are the following:

Bridge, Solano to Contra Costa Counties, Calif., to Duncanson-Harrelson, San Francisco, $4,500,000.

Hotel, Seattle, Wash., to Grant, Smith & Co., $4,000,000.

Bridge, Charleston, S. C., to Sanford & Brooks, Baltimore, Md., $1,067,466.

Home and infirmary, Buffalo, N. Y., to H. Schenk, Erie, Pa., $1,079,000.

Breakwater, Toronto, Ont., to R. Miller & Sons, $1,030,000.

Building Active in St. Louis

Building permits aggregating $2,371,005 were issued by the St. Louis Building Department during August, bringing the year's total to $25,705,355 or approximately $500,000 more than for the whole of 1922. In August, 1922, a total of 1233 permits for $2,206,670 were issued. The past month's total shows a slight falling off compared with July when 1393 permits for $2,906,463 in work were issued. Of the August permits 974 were for new work valued at $1,940,935 and 666 permits for repairs costing $430,470.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the the issue of Sept. 6; the next, on Oct. 4.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.00	$4.20	$3.40	$3.55	$4.20	$3.60	$4.10	$4.00
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.25	5.40	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	3.80	3.20	3.45	3.85	3.65	4.10	3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	+45%	45%	47%	53-5%	36%	33.2@42.2%	35%	—47.23
Cast-iron pipe, 6 in. and over, ton	+63.60	+60.00	63.00	60.20	60.50	69.00	62.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.70@2.80	3.00	2.25	2.20	2.50	2.84	2.63	2.90	2.25
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	1.89	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.83	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	—61.00	40.00	52.25	+58.50	+44.75	+44.25	—38.00	+29.00	70.00
Lime, finishing, hydrated, ton	18.20	22.50	22.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	2.35	1.50	1.50	2.70	2.10	2.80	10.00
Common brick, delivered, 1,000	23.65	—11.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.102	.115	.0724	.0816	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	—.1263	.102	.115	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	—.95	—.98	—1.10	1.14	—.99	—1.09	1.16	.86	—1.22
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.....	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	.50@.55	.35@.50	.50	.50@.62½	—.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.56). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.23; 6-in., $119.

Changes Since Last Week

Firmer tendencies in lumber and cast-iron pipe and a decided downward trend in linseed oil, characterize the current construction materials market.

Although pine timbers dropped $2 in New York and Douglas fir, $3 per M. ft. in San Francisco, during the last two weeks, fir advanced $1 in Minneapolis and Seattle and $1.50 in Denver, while pine rose $2 per M. ft. in Chicago.

Owing to heavier flaxseed receipts, raw linseed oil dropped 2c. in Atlanta; 3c. in New York and Minneapolis; 4c. in Dallas and 16c. per gal. in Denver, during last two weeks.

Gasoline is reported selling in Seattle at 16c. per gal.

The iron and steel situation may be briefly outlined as follows: Pig-iron prices stiffer owing to slowdown in production. Structural steel demand growing; lessening in car material requirement. Unfilled plate tonnage high. Tank plates and bridge material fairly active. Price of plates and shapes steady at $2.50 per 100 lb., Pittsburgh; premium of $2 per ton required on early deliveries in many instances. Bars firm at $2.40 base

Cement continues to maintain its price stability; few changes being noted. Fordwick, Va., mill, however, quotes to contractors, in carload lots, f.o.b., without bags, at $2.20 as compared with $2.10 per bbl. one month ago.